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ORIGINAL ARTICLES

FURTHER EXPERIENCE WITH THE .020 ARCH WIRE*

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IT is well known that until recently it was common practice among orthodontists to use the 16-gauge expansion arch; and as recently as 1914 in a paper read before the National Dental Association one of our leading orthodontists recommended the use of a 14-gauge iridio-platinum arch.

Nine or ten years ago, a number of men apparently about the same time reached the conclusion that they were using too much force, and began reducing the size of the wire used for the expansion arches. Being familiar with this trend in thought and practice, and having before me a difficult case, I conceived the idea of using the old Ainsworth principle of retainer as a working appliance, and to that end began the use of the 18-gauge iridio-platinum arch with pin and tube for the bodily movement of the molars and bicuspids when expanding the dental arch. This appliance was only used in a small percentage of cases, because I did not find it applicable to the anterior teeth, and did not find the way to either lengthen or shorten an intermediate section of the arch until later years. This same Ainsworth principle later came into great vogue when presented by another man as an original and revolutionary appliance.

The next step in the development of the appliance as I now use it came in 1911 when I began experimenting with 20-gauge in the form of a looped arch. These experiments were carried on with different forms and sizes of wires and different locking devices until 1914, when I published an article under the title, "A Looped Arch and Its Attachment," and later in the same year read a paper on this appliance before this society. In May, 1915, I read a paper before the Illinois State Dental Association, describing the use of the

*Read before the Seventeenth Annual Meeting of the American Society of Orthodontists, Excelsior Springs, Mo., Sept. 6, 1917.

.018 tungsten wire and the .020 platinum-gold wire. In this paper was also mentioned the use of the flat wire, and in the illustrated talk which accompanied the reading of the paper a locking device was shown and reasons given why the flat wire would never, in my opinion, be a success. Since that time, as is well known, the same man, who presented the Ainsworth principle as his own original devise has presented another original and revolutionary appliance called the ribbon arch, the arch being the same and the locking device a slight modification of the device shown at the Illinois meeting. These may seem extraneous matters, but they are interesting side lights on the development of appliances.

As time has gone on I have found myself fully justified in the use of the smaller sized wires. It is now about three years since I have used any wire larger than .020. A proper wire of this size will develop all the force necessary to perform any movement of the teeth as rapidly as is consistent with the proper development of the bone for their support. It will not, of course, move teeth as rapidly as would the 16-gauge arch; but, when the period of retention is taken into consideration, the whole period of treatment and retention will average much less with the .020 wire than with the larger and more powerful appliances. The smaller wire also performs its work without the soreness which attends the use of the larger appliance, and this factor does not receive the attention which it deserves at the hands of most orthodontists. When it is stated that it is not necessary to produce soreness in correcting malocclusions of the teeth, the statement is absolutely true.

Bodily Control.—The operator's control is only limited by his desires, because it is only necessary to place the block on the wire at the angle to which it is desired to move the tooth and then spring the block into its seat and lock it there. While the pressure on the tooth will be very slight, it will be sufficient if given proper time to bring the tooth to the desired angle.

Technic.—Since my last article was published I have modified the technic by changing the method of attaching the block to the wire this now being done without soldering by making the attachment rigid only at the arch ends and by moving the arch from the bucco-labial side of the teeth to the palato-lingual side. This has not only made the appliance less conspicuous, but has greatly added to its efficiency, and much reduced the liability of breakage. The technic of construction and application is so simple and liability of error in either direction, or amount, of force is so small that it would seem that the average man could well handle the appliance. This does not mean that any student or dentist can purchase a coil of .020 wire and immediately become an efficient orthodontist, because as has always been the case, the most important thing in orthodontia, as in any branch of the healing art, is the ability to make a proper diagnosis. By a proper diagnosis, I do not mean merely the ability to tell whether a given case belongs to Division IV, of Section X, or whether or not it be a case of neutroclusion, but I do mean the ability to look at a case of malocclusion and in the mind's eye see the changes necessary to make it normal occlusion. I mean the ability to look at the abnormal and from it visualize the normal. The work of Angle and Lischer has been of great value in assisting orthodontists in learning to make correct diagnosis. But I

much fear that many depend on the letter of these classifications, and never catch the spirit of them, as in years past this same type of operator tried to make all cases conform to the size and shape of the expansion arches as purchased from his dental supply house.

But, granted a proper diagnosis; and treatment should never be discussed until that is granted; the construction and application of a proper appliance with the .020 wire presents fewer difficulties to me than do any of the other forms of appliances before the profession at this time. Once the size and shape of the desired arch has been determined, it does not seem a difficult matter to construct and apply a wire arch of the length and shape necessary to bring the teeth into the desired positions. The wire is small and can be readily bent into any desired shape, and being small and easily sprung, it can, after being formed into the size and shape of the true arch already determined, be made to assume the size and shape of the arch as it is with the teeth in malocclusion. If this be done and the wire arch locked into such positions, the resilience of the wire will slowly and gently move the teeth into their correct positions. It will do this with a minimum of attention on the part of the operator and a minimum of annoyance to the patient.

In those cases in which rotations are necessary, two wires are used,—one on the labial and one on the lingual side, each being made to conform, in shape and size, to that portion of the true arch which it is to occupy. This, as with the Lourie appliance, obviates the spaces between the teeth made necessary by the bands in those appliances which call for a band on each tooth to be rotated.

Locks.—In the evolution of this appliance I have made and tried nearly thirty forms of locking devices. The form I now use was devised in 1914 and has been in constant use since that time, although during that period I have made and tried various other forms, only to discard them. The lock is efficient. It will lock the wire and hold it rigid under the strain of moving the teeth and under the stress of mastication. It will, if properly locked, stay locked; and it can, at the operator's will, be unlocked. It can be locked and unlocked *ad infinitum.* But it matters not whether the lock devised by me be used or some other, provided such other device will do the things which this will do. I believe some day a better lock than mine will be devised. I have clearly in my mind the requisites for a better locking device, but I have, so far, been unable to overcome the mechanical difficulties necessary to its production. I have made several forms that in the laboratory worked beautifully, but when put into the mouth, were failures.

The thing which I do wish to advocate is not this lock or that, but the principle of the little wire, the principle of the small amount of force that is constantly applied as opposed to the greater force intermittently applied.

The difference in the principles of appliances as I see them can best be stated as follows:

The old Angle expansion arch was a rigid appliance bent to conform to the outside of the ideal dental arch. To this rigid form the teeth were drawn by means of various forms of ligatures. The pin and tube appliance and the present ribbon arch are lighter. They may be said to be semirigid appliances

bent to conform to the teeth as they are in malocclusion. From time to time they are removed and bent to a form more nearly resembling the true arch. The appliance which I use is a nonrigid arch made to the size and shape of the true dental arch, but of material so flexible that it can be readily sprung to the size and shape of the arch as it is with the teeth in malocclusion, and so resilient that it will, when properly locked to the teeth, carry them toward their proper places. If we could have a wire with 100 per cent of resilience, this is all that would be necessary; but as we have no such wire, it becomes necessary to reshape the arch at intervals. Its advantage over the heavier semirigid appliance is that the smaller wire can be so adjusted that it will work through a long range of distance and over a long period of time without at any time exerting more than a very slight pressure. This can not be done with the heavier appliances, and it is this which assures that the work will continue even though the patient be away from the operator for a long period of time, and it is this same characteristic which permits great movement of teeth without the soreness which attends the use of the heavier and more violent appliances and those which are intermittent in their action.

I see those of my patients who live in my home city but once each month; those who live in other places, three or four times in a year, and in one instance the appliance was put into place and circumstances were such that the patient could not return for more than a year. Although this required a complete reshaping of both dental arches when she returned, the work was found complete except that an erupting tooth had been allowed to go inside the arch wire. One adjustment of the appliance completed the work to everybody's satisfaction.

DISCUSSION

Dr. D. W. Flint, Pittsburgh.—It was my pleasure to spend some time in the office of the essayist, and in discussing his paper I can vouch for what I have seen, and from what we saw last night from our old friend Dr. Case, a great evolution has taken place in the sizes of wire we use. From the very large arch wire we have come down to the almost ridiculously small wire as Dr. Case showed us last night. There is one thing to remember, however, and that is, in talking about small (alignment or arch) wires, they can not be used by every person because there are some people who will not take the time to study force. The smaller the wire you use, the more care you have to use to see that it does not exert force in a place where you do not want it. In using small wire, if you are not watchful of its force, you will get into trouble in handling it. I have seen excellent work done by this small appliance, which was a revelation to me. I have been using wires as small as 19-gauge. I am highly pleased in seeing what the doctor has done. At the Toronto meeting the appliance he showed us was rather crude as compared with the one he uses today, and I believe the appliance he used at that time has been largely discarded by him.

Dr. L. S. Lourie.—I am particularly pleased with this presentation of Dr. Robinson's efforts for two reasons, one of which is that my first choice is always a lingual appliance where I can use one that is not too complicated and when it will do the work as well as a labial appliance. My reason is this: With a lingual appliance many times bands and ligatures can be dispensed with, whereas with the labial arch, bands and ligatures would be required to pull on the teeth instead of the pushing principle exerted as exemplified in the lingual arch.

Dr. Robinson has done a great service for orthodontia in emphasizing the point of using smaller and smaller gauge wires for moving teeth. In using small gauge spring wire on the lingual side he is able to use a smaller gauge wire with more safety than if

the same gauge were used labially, because he has a shorter length of wire and more perfect control over it.

Dr. Flint has pointed out that the smaller the gauge of the wire used and the longer the wire, the greater the danger in using it. I would also add, the more bends and modifications that are made in a wire, the more difficult it is to use.

In my paper which is to follow, I find it necessary to criticize Dr. Robinson's previous appliance along with the pin and tube and ribbon arches, because they work upon the same principle, that is, inconstancy of the appliance from the spring reaction. However, he avoided that criticism by discarding the other appliance and adopting this newer one. I believe the principle is very good, and is one that can be made use of if the proper care be exercised. To attempt to get an appliance which you can adjust and use for the average case and say that two or three adjustments will be all that is required, is misleading. It will do a great deal of harm.

I am glad to have heard Dr. Robinson, who has had experience with a wide variety of appliances, say that he has changed his ideas in that respect.

Dr. Manly Bowles, Winnipeg.—I had the pleasure a few days ago of being in Dr. Robinson's office. He showed me a patient he had in the chair and I can vouch for the condition of the teeth. While, as he said, the case was not completed, it was progressing very well. The teeth were moved bodily. I also saw the models where he had applied the tungsten wire. It is true he did not obtain ideal occlusion in one application, but I think that if every one had as good occlusion as was obtained by that one application, the members of this society would find little work to do. My own experience with Dr. Robinson's appliances has been very limited. In one case I had success, in another I did not.

Dr. Burt Abell, Toledo.—I would like to have Dr. Robinson explain to use if he finds any difficulty in expanding the molars at the end of this light wire. It seems to me, there should be some difficulty in doing that with this light wire.

Dr. C. A. Hawley, Washington, D. C.—There does not seem to be very much difference of opinion as to the value of lighter wire. The tendency seems to be all in that direction.

I was much interested in Dr. Robinson's paper at Toronto, and I have used one or two of his appliances. In his earlier appliance, the one he described formerly, I found the same difficulty that he and Dr. Lourie have mentioned. The attachments to be made to every tooth are all reactive forces. The advantage in the present appliance in the use of lighter wires, and the relief from bands, it seems to me, has not been sufficiently emphasized, it is an advantage from a hygienic standpoint. I do not think anybody will fit fixed bands to the anterior teeth and avoid all irritation. It is almost impossible to get correct hygienic conditions. The later evolution of the appliance presented by the essayist is a great relief from that condition. These lingual wires that can be removed and make possible ideal hygienic conditions in the mouth. If we can rotate teeth with a combination of labial and lingual wires without covering them with bands, there is a tremendous advantage, not only from a hygienic standpoint, but from an esthetic point of view. Neither the patient nor the operator likes bands on teeth, and in the last two years or more there have been tremendous strides made in orthodontia in that direction.

Dr. Ray D. Robinson, Los Angeles.—There is nothing further I have to say except to answer Dr. Abell. Why should there be any difficulty in expanding the molars? You can expand them where you will. Just as you widen your wire arch you can expand the molar or bicuspid region and expand it where you will.

Dr. Abell.—Is the force enough with that light arch?

Dr. Robinson.—Yes. There was over half an inch expansion in the molars and bicuspids, and there was plenty of force there. It is only a tiny bit of force that is constantly applied that will do it. If an appliance is put on today you can not expect results tomorrow or next week. If you use an appliance for a period of two or three months you will get results. It is like water wearing away stone, a little force will produce it. You can expand molars or bicuspids wherever you wish.

THE HISTORY OF ORTHODONTIA

(*Continued from vol. iii, page* 618.)

By Bernhard Wolf Weinberger, D.D.S., New York City.

NORMAN WARREN KINGSLEY (1829-1913), the foremost of the early modern pioneers in our branch of dental science, described by one of our historians as "the father of orthodontia, author, artist, sculptor and inventor," began to publish occasional papers on regulating and palatal deformities as early as 1858. These practicable contributions became more numerous in the prime of his professional career, and through his individual influence, he succeeded to some extent in simplifying orthodontia.

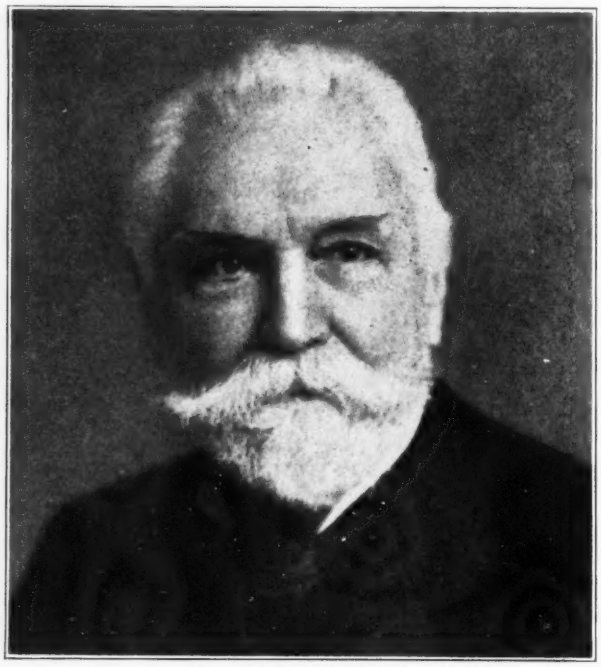

Fig. 1.—Norman Warren Kingsley (1829-1913).

In December, 1879, he brought together the scattered knowledge of what is now our science, culminating his efforts in what was the first American treatise scientifically and comprehensively treated. His "Treatise on Oral Deformities as a Branch of Mechanical Surgery" was a standard textbook for many years and will always be considered a valuable contribution to orthodontia. It comprised, not only the results of his own labor, but summarized the efforts of those who preceded him, thereby stimulating to a greater degree the treatment of malocclusion of the teeth. The volume embraced seven chapters on irregularities of the teeth, their etiology, diagnosis, and treatment, besides a consideration of cleft palates and fractures of the mandible and their treatment.

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Although Westcott and others had previously used the head cap for occipital anchorage, Kingsley, twenty years later, reintroduced this method, and for over forty years it proved the only successful method of handling extreme cases of malocclusion. The greatest credit is due him for being the first to successfully "jump the bite," as he proposed and executed the bodily movement of the mandible from a posterior position forward into normal occlusion with the maxillæ.

He also made use of the head cap to shorten teeth by retracting them within the jaw after they had elongated through "natural or developmental causes."

Kingsley greatly extended the usefulness of vulcanite, employing it in many ways and making it the basis of the greater part of his appliances. He also made use of the jackscrew, arch, elastic bands, and ligatures.

It will be impossible to review his articles as extensively as they should be, for time and space will not permit. His book is to be had and should be read carefully. It will not be possible to take up all his papers, only the most important being mentioned.

As the subject of etiology of irregularities has been brought together in his book, it will perhaps be best to review it there.

Irregularities of the Teeth (pages 1 to 25). "Irregularities, either in the form of the arch or the position of the teeth, are very uncommon in the deciduous set. We have seldom seen an irregular arch in a child prior to the eruption of the permanent teeth, unless associated with and correlated to some other deformity. In a few instances there has been observed a slight malposition of one or more of the incisors, sometimes of congenital origin, and sometimes the result of mischievous habits; as, for example, the two centrals may be pulled forward by the prolonged use of an artificial nipple, sucking the thumb or other similar habit.

"Congenital deformities rarely amount to more than a trifling displacement of one or two of the incisors; but, considering the temporary character of the deciduous teeth, and more especially the incisors, no irregularity in their position that we have seen can be regarded as of special importance, or as justifying any interference for its correction. They are to be classed as mere freaks of nature not associated with nor indicating any other peculiarity in the child. Nor do they prognosticate an irregularity in the development of the second set. This important fact can not be too prominently borne in mind. The deciduous dental arch is always well formed, and the positions of the teeth are regular (mere freaks of nature excepted). But from this perfectly symmetrical dental arch there develop with the growth of the permanent set some of the most astounding abnormalties.

"Symmetry and harmony do not imply uniformity; and the dental arch may be developed up to the highest type of perfection, and yet there exists as great a variety of form as there would be in the faces of the aggregated beauties of the world. Races, nations, and families are thus represented without deformity.

"In classifying the causes of irregularities, they will be placed under one of two heads—developmental or accidental; the developmental operating prior to the eruption of the crowns, and the accidental at the time of eruption or subsequently.

"The premature extraction theory rests upon the supposition that the jaw-bone contracts upon the removal of the deciduous teeth. The fact seems to have been entirely ignored that the teeth and alveolar processes are a superstructure of the jaw-bone, growing up on it, fulfilling their destiny, and passing away, without disturbing the foundation much more than an oak disturbs the planet upon which it has been sustained.

"Whatever may be the inducement to remove any or all of the deciduous teeth prior to their period of shedding, the canines should be retained until there is ample evidence of the early emergence of their permanent successors, unless the health or comfort of the child would be sacrificed in so doing.

"The question naturally arises, 'Is the presence of the deciduous teeth the cause or the effect of the irregularity?' If their presence be the cause of irregularities, then it is manifest that in this generation of malposed teeth it is our duty to anticipate the trouble, and at an early day remove them before even it is possible for them to give a wrong direction to their successors.

"Many of the forms of irregularity are directly traceable to inheritance, and are transmitted peculiarities. Probably in a large proportion of cases where the irregularity in a dental arch is confined to one or two teeth, the primary cause, so far as that individual is concerned, is a hereditary family peculiarity. The teeth of every person possess more or less individuality, and most of those peculiarities which stamp their individuality are inherited. The form and color of teeth, when not disturbed by abnormal influences, are derived from the same source. Whenever we find any departure from what we are apt to regard as the typal form of each tooth, or any disproportion of size in their relations to each other, we shall be likely to find them peculiarities of descent.

"There is one form of irregularity which is sometimes due to hereditary predisposition and sometimes to causes acting after eruption. An undue prominence of the upper incisors may be either congenital or acquired. The acquired origin is almost always a habit of thumb-sucking or its equivalent. It it not difficult, as a general thing, to make the distinction even without questioning the patient. In a protrusion of congenital origin the jaw is generally pinched in the bicuspid region, and the protrusion culminates in a pointed or V-shaped position of the central incisors. When such prominence has a mechanical or accidental origin, the whole front of the arch will be found rounded out, and the teeth pulled forward; and there will be likely to be more or less space between each of the teeth anterior to the biscuspids.

"A perfect dental development is the result of well-balanced physical and nervous systems, without hereditary taint.

"The causes of irregularities we classify as developmental and accidental; the developmental operating prior to the eruption of the teeth, and the accidental subsequently.

"Abnormalities of development having their origin in the same individual are due to a disturbance of the trigeminal nerve during the period in which the crowns of the permanent teeth are forming and arranging themselves in the jaw prior to eruption; or, when arising from causes antedating the life of the individual, are traceable to an inherited tendency, which tendency had its origin

in a like disturbance in one of the progenitors, and was subsequently transmitted; or are the result of mixing different and distinctly marked types of jaws and teeth by the progenitors.

"This proposition may be stated in another form as follows: The cause of irregularities of the teeth other than accidental lies in a want of development of the jaws commensurate with the size of the teeth; and this want of relation is sometimes due to a retarded growth of the jaw while the development and eruption of the teeth is not retarded, and sometimes due to the inheritance of large teeth out of all proportion to the size of the inherited jaw.

"In our view we do not call a feeble mind, a sluggish brain, or a dull intellect a nerve-lesion or a brain-disturbance; for it is abundantly proved that when this condition is associated with an average physique, the development of the dental organs is tardy, but in regular order.

"No force operating on the brain can interrupt or alter the type or inherited model of the dental arch, after the first decade of life. All cerebral disturbances occurring during that period, showing mental aberration, we should class under the head of idiocy—imbecility. After that period, such manifestations come more properly under the head of lunacy—insanity—which might degenerate into imbecility or idiocy. Consequently, neither lunacy nor insanity, in the ordinary acceptation of the terms, can have any direct bearing upon the development of the dental organs; but such a condition would be most potent of evil if transmitted to offspring.

"I do not hesitate to place it upon record that the next generation will see more of abnormality in dental development, and an increase of nervous and cerebral diseases, and that the two are correlated and spring from the same cause. It is too late to stop it in those who have passed infancy, but it is not too late to modify and partially remedy the evil in those now being born, and those who may be begotten hereafter.

"An erroneous teaching has maintained that the full number of teeth must be retained in the mouth, regardless of their organization, the progress of decay, the limited capacity of the arch, or the external features.

"Two arguments are advanced to support such a judgment: First, that a certain number of teeth are developed by nature, and therefore every one must be preserved. A second argument in favor of retention of all the natural teeth is, that the alveolar arch and the associated maxilla will become contracted, narrowed, pinched, as the result of such loss, consequently the articulation of the teeth broken up and the efficiency of the masticating organs impaired.

"The articulation of masticating organs is of much more importance than their number, and a limited number of grinding teeth fitting closely on occlusion will be of far greater benefit to the individual than a mouthful of teeth with the articulation disturbed.

"It is often better to extract a malposed tooth than disturb a whole arch to bring it into line.

"In hereditary cases of extensive character, which have been delayed until at or near maturity, we can never feel certain but that the original tendency to malposition, so long unbroken, will reassert itself at any time that we abandon retaining fixtures."

Treatment of Irregularities, published in *Dental Cosmos,* 1872, page 63:

"This treatment consisted entirely of wedges which were inserted between all the teeth, and worn from the first. These wedges were of elastic rubber, and used of such thickness only as would exert a gentle pressure. The retaining-plate answered a twofold purpose: it kept the teeth from the possible contingency of any one of them moving toward the center of the mouth; and secondly,—that which was of equal importance—points of the retaining plate were allowed to pass between all the teeth, which kept each wedge from slipping up into and irritating the gum.

"I have heretofore claimed something for esthetic art in the practice of dentistry; for the above I claim nothing but a recognition of pure mechanical principles in dental practice. The wedge is one of the recognized mechanical powers. Its application here is identical with its use by the architect for a keystone in building his arch. Drive in the keystone and the arch is necessarily enlarged, and will continue to be enlarged so long as a wider keystone is admissible, and there is a support which will prevent the whole arch from tumbling in ruin to the center.

"In a course of lectures delivered on this subject, I took the ground that everything relating to the means to be used in regulating teeth was purely mechanical, and the history of inventions has shown what marvelous works are accomplished by the most simple of mechanical contrivances. The foregoing case illustrates that the simplest of all mechanical powers wrought all that could have been done by jackscrews, levers, inclined planes, straps, bands, and pulleys, combined."

Under *Irregularities,* page 130 in *Johnston's Dental Miscellany,* 1874, Kingsley describes the following method of treating the "V-shaped maxilla."

"The treatment consisted of a plate of vulcanite adapted to the roof of the mouth. A hook of gold was inserted in the plate against each molar, and a little T-shaped catch was made of gold to pass between the centrals. Before introducing the plate, a rubber ring cut from tubing was secured to one of the hooks at the back of the plate, passed through a loop made in the stem of the T, and caught upon the hook on the opposite side. The plate was then adjusted to the roof of the mouth, and the T brought forward; its stem, being quite thin, was passed between the centrals, and the crossbar caught on their labial surfaces. This was the only treatment the case received, and in seven weeks the result was secured.

"The above case illustrates how great a work can be accomplished by a very simple means, and yet this kind of an appliance might not be of any benefit in any other case except one exactly like the above. This case would very naturally be termed one of a 'V-shaped maxilla'; but it was not a V-shaped maxilla.

"It was a V-shaped, or triangular, dental arch—an arch in which the sides from the base to the center were not curved as they should be, but nearly on a straight line. I believe therefore, that the apices of the roots were in the maxilla upon their normal line; the crowns of the incisors thrown beyond the line, and the side teeth drawn within it. Had it been otherwise I do not believe

that force alone, on the center, like pressure made on the keystone of an arch, would have produced the desired bulging at the sides.

"As to its cause, I have no knowledge sufficient to prove its hereditary character. I do not believe it to have been the result of 'thumb-sucking' nor 'fruitless sucking' of any kind. It was not associated with 'enlarged tonsils,' nor did the patient habitually keep the mouth open for breathing, and thus (as it has been claimed) have the sides of the arch unduly pressed upon."

On page 172 of the same publication in treating another "V-shaped maxilla" Kingsley states: "All of the teeth anterior to the molars are so related to each other that pressure on one point would cause the arch to collapse. Even if a plate had bridged the palate and come in contact with the teeth at the sides, so as to prevent a collapse, no force upon the center as they now stand would have carried those teeth outward. A fixture operating like the T would not have affected the bicuspids and molars, but would have drawn the middle incisors toward the center in the same twisted condition, and would have moved the laterals and canines irregularly apart.

"The widening of the arch, therefore, which is of primary importance, must be effected by other means.

"The correction of the deformity necessitated three separate stages and three distinct operations, as follows: first, the widening of the arch; second, the twisting of the central incisors, and third, the reduction of the V to a proper curve.

"The widening was produced by a jackscrew; that most effective of all known agencies wherever it is applicable.

"Its mode of adjustment is very fairly shown. A plate of vulcanite was made as there represented, so thin and elastic along the center that it would straighten under moderate force, and so stiff where it came in contact with the teeth that it would not yield. The attachment of the jackscrew is made after the vulcanite plate is finished, and is readily accomplished by carefully cutting a little mortise in the plate on one side and allowing the point of the screw to rest in a pit on the opposite side. This case was retained by a simple plate of vulcanite with a small gold wire embedded in it and passing to the outside of the six front teeth, through a small gap between the cusps of the canine and biscuspid on each side. If the articulation of the teeth of both jaws had been such, on occlusion, as to shut this gap, then this kind of retaining plate could not have been used." (Fig. 2.)

In February, 1875, in *Johnston's Dental Miscellany,* Kingsley illustrates his use of the head-cap to shorten the teeth by retracting them within the jaw after they had elongated through "natural or developmental causes." Perhaps the first effort to accomplish this movement of the teeth was that made by Kingsley in 1866, reported in the same year at the May meeting of the New York Dental Society and published in the *Dental Cosmos.*

Cases of Irregularity.—"In the child the incisors were protruding, and the whole upper jaw gave the appearance of being excessively large. The teeth of the lower jaw were normal.

"The teeth behind the canines were all in contact and articulated well

with those of the lower jaw, but the incisors were spread and straggled, and the crowns had the appearance of being of extraordinary length.

"As interference need be no longer postponed, I made a frame of gold, covering the cutting edges of the incisors, and lapping on to the canines, and a plate of vulcanite adapted to the roof of the mouth, such as described in former articles, and cut away in front to provide for the retrocession of those teeth. Ligatures cut from rubber tubing were attached to the posterior part of the vulcanite plate, one on each side, and drawn forward and caught on projecting spurs of the gold frame. This apparatus, which can be easily understood from the description, was worn for a short time, when two discoveries were made. First, the arch in front was by this means contracted, until the teeth came in contact, but was not sufficiently reduced. With the teeth all now in close contact, there was no hope of further reduction without the removal of a tooth, and the first bicuspid on each side was consequently extracted. Secondly, the backward movement showed an apparent elongation of the incisors. I do not think

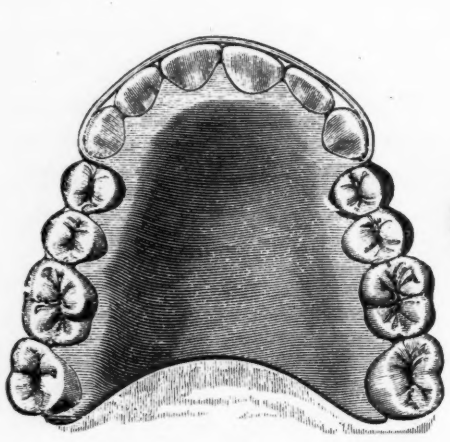

Fig. 2.

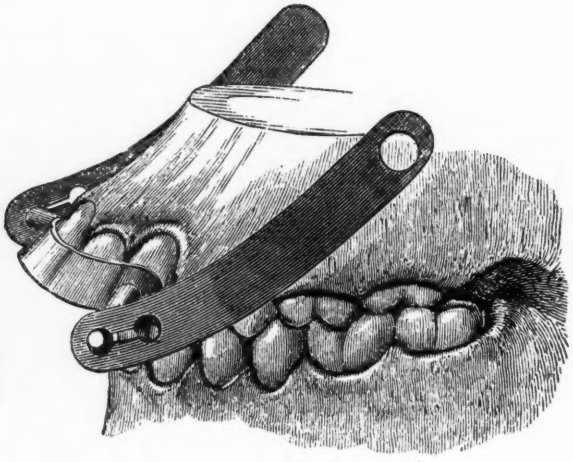

Fig. 3.

it was an actual elongation, but an appearance arising from crowns of an already extraordinary length becoming more perceptible as they came into a vertical line.

"It became evident that any further pressure in the same direction would eventually carry the teeth down so as to touch the gum of the lower jaw, thus completely hiding the lower incisors and producing a deformity but little preferable to the first.

"In this emergency I conceived the attempt to shorten the crowns of the upper teeth by driving them up into the jaw.

"I continued the apparatus as before described within the mouth, and added to the gold frame a stud or post about half an inch in length, soldered to it opposite the canines, and coming out of each corner of the mouth. This apparatus, when in position, is shown in Fig. 3. The arms extending upward, passing outside the cheeks, were made of strips of brass, and were connected by elastic ligatures with a skull-cap as shown in Fig. 4.

"This skull-cap was made of leather, and the whole apparatus was very easily applied as follows:

"The vulcanite plate was inserted in the mouth, and the rubber ligatures brought forward and caught as before described, the skull-cap placed on the head, and strong elastic straps were caught over buttons or hooks on the cap, and like buttons or hooks on the cheek arms. The action will be understood by observing Fig. 4. The outside pressure was forcing the teeth up into the jaw, while the pressure inside was carrying them in a direct line backward.

"The success in this case involved absorption of the walls of the socket, and is not to be confounded with some cases which I have seen since reported, where a tooth had become elongated by accident, as, for instance, the presence of a rubber ring around the neck of the tooth, and pressure was resorted to, to restore it."

On page 212 of the above mentioned publication of the same year, we find

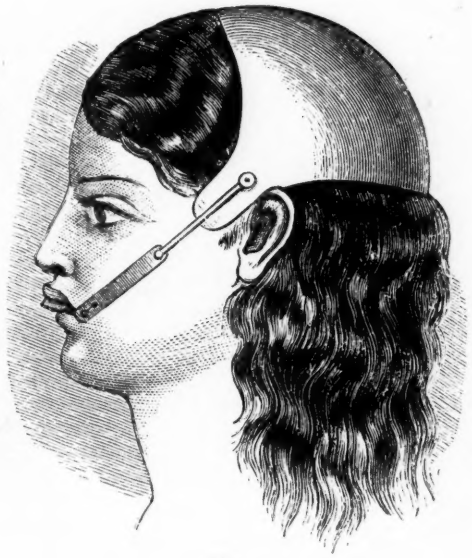

Fig. 4.

the report of a case Kingsley presented before the New York Odontological Society. In this case he discovered that it was necessary, in order to reestablish normal occlusion, to bring about a new articulation.

"In all cases which I have heretofore observed of a well-shaped lower arch associated with a V-shaped upper one the articulation was not good, the lower bicuspids and molars articulated outside the cusps of their superior antagonists. I was puzzled over this anomalous state until my plaster models were made, and with a better opportunity of studying the articulation, I discovered that the lower teeth were articulating one tooth behind their normal place in the upper jaw, that is, the first bicuspid of the lower jaw was shutting between the bicuspids of the upper jaw, while in all cases the normal occlusion requires that the lower bicuspids should shut in advance of their correspondents above. In my plaster models I was able to see the perfection of articulation in this state of malocclusion, and also to see that the movement to shut the lower

jaw farther forward showed the upper jaw too narrow to receive it. It was thus that I obtained a clear insight into the cause of the deformity.

"The remedy evidently lay in the widening of the upper jaw until the lower would be received in its forward and natural place; and resolved itself, therefore, into three elements; viz., widening the upper arch so that the lower teeth could not articulate as they had been accustomed to; secondly, compelling a new articulation in an advanced position; and, thirdly, flattening the pointed and projecting appearance of the incisors."

Under *Regulating Teeth* in the January number of *Johnston's Dental Miscellany,* 1877, Kingsley described different applications of the jackscrew.

"Fig. 5 shows the employment of two screws upon the upper jaw. The

Fig. 5.

Fig. 6.

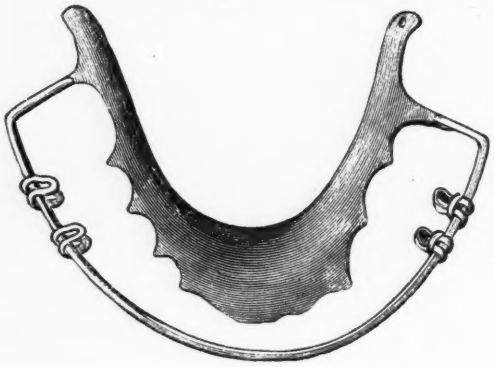

Fig. 7.

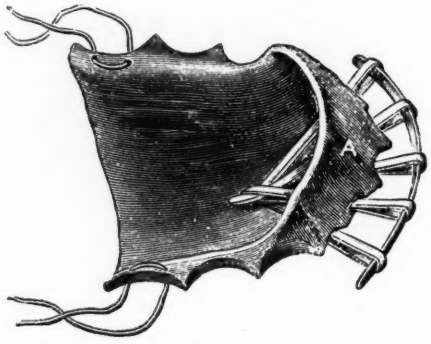

Fig. 8.

plate was of vulcanite, and the screws have no other nut than the plate itself. The plate was vulcanized around the screws, thus making the thread very perfect. This plate was used to drive out a very stubborn canine, and also to twist a central incisor.

"Fig. 6. is an illustration of the same principle applied to both sides of the lower jaw, and was used in a case where the inferior dental arch was narrowed and the canines pushed outside the line. Elastic straps were attached to the extremities of the plate, as seen in the engraving, and drawn forward over the canines, which came into line as soon as the arch was widened. The spreading of the lower jaw is ordinarily much more difficult than the upper, and such appliances as Fig. 6 possess peculiar advantages in utilizing the extraordinary power of the screw, when the presence of the tongue would make a screw bearing directly on the teeth inadmissible.

"The following engravings will illustrate some of the appliances of elasticity.

"Fig. 7 shows a combination of vulcanite and gold wire for bringing into line certain irregular teeth upon the lower jaw.

"It was a former practice in a case like this to use the wire band independent of the plate, the ends being tied with silk or twine ligatures to the molar or biscuspid teeth; but experience showed that the ligatures were apt to irritate the gums, besides giving much trouble whenever the fixture was removed for cleaning by the difficulty of retying. Consequently, the wire was carried over the teeth, selecting such a gap when the jaws were closed as was most favorable, and the ends of the wire anchored in vulcanite. In this way perfect facility in removing and replacing was obtained.

"Another advantage derived from fixing the wire in a vulcanite frame is the steadiness with which the wire is kept in relation to the teeth.

"In drawing teeth toward a wire, rubber elastics exert a constant tendency to force the wire into some position where the elastics will not remain on the teeth, particularly the incisors and canines."

Treatment of Irregularities with Inclined Planes and Levers, in April, 1877, issue of *Johnston's Dental Miscellany,* page 121:

"Fig. 8 shows another application of an inclined plane somewhat out of the ordinary course.

"It was adapted to the inside of the superior dental arch, and the inclined surface marked *A* projected below and caught the inferior incisors.

"The object was, not to protrude the lower teeth, but to change or jump the bite in the case of an excessively retreating lower jaw.

"In the engraving the appliance is shown bottom up, to exhibit more clearly the attachment of some elastic ligatures which were caught on a hook in the roof of the plate, and were drawn out through corresponding openings, and connected with a gold bar worn across the front of the superior incisors to reduce their prominence.

"The fixture was worn constantly, and in a few months produced the desired result. The objection urged against the use of an incline, because the time required had a tendency to alter the articulation of the teeth, was in this case an argument in its favor, and an advantage, because a new articulation was desired, and the incline, as adapted, offered no opposition to the antagonism of the teeth.

"The principle of the inclined plane is always operating in the mouth, and may often be taken advantage of beneficially, while at other times it will tax our ingenuity to the utmost to overcome its powerful influence. In the case of the superior incisors shutting within the lower, after they have been brought forward so as to barely catch over the lower ones, then the principle of the inclined plane becomes available in completing the operation.

"The points of the lower teeth, catching within the upper ones, strike their natural inclined surfaces, and nature may be relied upon for the rest.

"In moving the bicuspid teeth of the upper jaw, either outward or backward, all that is accomplished by fixtures may be entirely overcome by the articulation of the lower teeth forming an inclined plane, and thus acting upon the upper ones to return them to their former places.

"Levers do not come into such universal application as do some other powers; the principal objection being, that the limited space of the mouth does not permit their unrestricted movement.

"Levers may be used to advantage in revolving teeth in their sockets; and for this purpose a band around the tooth is necessary, which will not slip, and the lever will be attached to the band. Force may be brought against the long arm of the lever by ligatures connected with convenient teeth. Such an appliance will pretty surely accomplish the result, but it can generally be obtained with a less cumbrous fixture.

"Levers may often be advantageously used on the outside of the arch, to press gently against some offending tooth, and thus drive it into its desired position.

"One figure illustrates a method of reducing one or more teeth to a regular line by means of a wire or bow going around the outside and acting partly as a lever and partly by the force of elasticity. The engraving sufficiently explains the action. The plate is of vulcanite and an elastic loop acts to contract the circle by drawing the ends of the wire together.

"There was a wide gap between the lateral incisor and the canine tooth, and the opening extended through the alveolar arch and into the nasal passage.

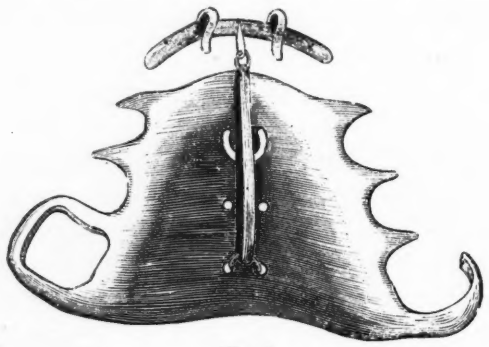

Fig. 9.

"It was desired to bring the maxilla into contact, and a fixture like the last would only act upon the teeth, tending to give them a wrong inclination." "This fixture was made to embrace the gum as well as the teeth with the wire running through the length of the vulcanite to give both stability, and the terminal hooks were drawn toward each other when *in situ,* with a silver wire wound around and twisted with a pair of pliers. In the process of twisting, the gap was seen to perceptibly close, and ultimately came together and united."

Before the New York Odontological Society, February 18, 1879, Kingsley introduced a new and novel method of regulating teeth. This method is described in the *Dental Cosmos,* page 323, of that year.

"A new vulcanite plate, adapted as a retaining plate to the widened arch, was introduced, and this became the anchorage of another rubber strap, to which was attached, for greater convenience, a little gold crossbar for the incisors with a little stem and an eyelet, passing between the teeth, as shown in Fig. 9. The stem was long enough to rest its end upon the vulcanite, and thus keep off pressure from the gums. To keep the crossbar from slipping up into

the gum, a little hook came down over the cutting edge of each central, and thus completed the appliance for regulating, save that as the centrals became flattened the crossbar was lengthened to bear on the laterals, and at a later period and for a short time only included the canines. The horseshoe-shaped opening seen in the plate, Fig. 9 was made as a ready means of attaching the rubber ligature, but in consequence of the lengthening of the stem of the brace the ligature was afterwards fastened farther back, as seen in the engraving. In just five weeks from the day when the operation was commenced, the process was completed.

"I desire to call your attention especially to the simplicity of this whole apparatus.

"One or two vulcanite plates so devoid of intricacy that any one could make and adjust them; and although the crossbar and stem may seem a little more complicated, they are really not essential to success. By pulling the rubber forward and tying it to a bit of broken match, the same flattening of the centrals would result."

In the thirty-fourth volume of the *Dental Cosmos,* 1892, pages 16, 100, 357, 442, we find undoubtedly the most important series and contributions that Kingsley gave to orthodontia. Although entitled *Adenoid Growths, Mouth-Breathing and Thumb-Sucking in Their Relation to Deformities of the Jaws and Irregular Teeth,* he describes, for the first time, "jumping the bite," unquestionably one of the greatest adjuncts we have in our treatment of orthodontic cases. The case described is one of the open-bite types.

"The opening of the jaws in front was due slightly to the projection of the incisors, but principally to an excessive and abnormal development of the alveolar process in the molar and bicuspid region, and the remedy must be in its reduction; or, in other words, the teeth and processes must be driven higher up.

"The pitch and projection of the upper incisors would have been heretofore attributed to thumb-sucking or its equivalent, but that practice had never been acquired; the child had never been a thumb-sucker. Still we find typical thumb-sucking case where there had been no thumb-sucking,—a perfectly developed and symmetrical lower jaw and a strangely abnormal upper one, coincident with adenoid growths of the pharynx and long-continued mouth-breathing.

"It will be observed that the upper jaw is also normal in width and outline, and the back teeth of the upper jaw occlude or articulate properly with the lower ones; the opening of the mouth has not, therefore, caused a pressure of the muscles of the cheeks upon those teeth and narrowed the jaw.

"As a proper correction of this deformity required the incisors to be carried backward somewhat, and as there appeared to be no spaces in the arch which would permit of its contraction, the first or sixth-year molar on each side was extracted."

Up to this time Kingsley believed it was necessary to extract teeth to correct irregularities of the teeth, but after completing the case recorded he in his own words proves the fallacy of this procedure. "I am convinced by a study of the case since the correction was completed, that the extraction of those permanent teeth was unnecessary. I find now, to my surprise, that although there

then appeared no room to carry the incisors back without extracting two teeth, there are now ample spaces among the teeth on each side to permit of another tooth.

"The first attempt at correction was made with a skeleton skullcap, as seen in Fig. 10, a padded cap over the chin (shown in Fig. 11) and a frame over the incisors, with arms projecting outside the cheeks, as shown in Fig. 12. The

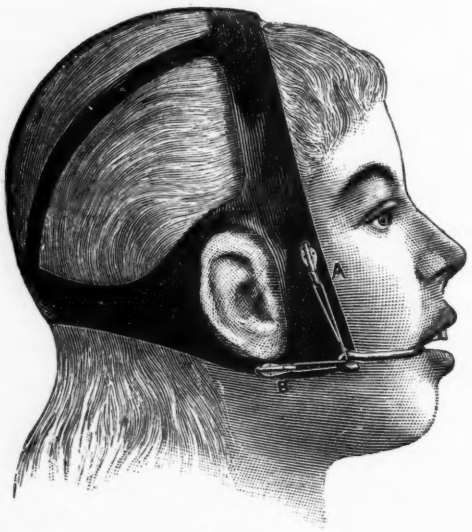

Fig. 10.

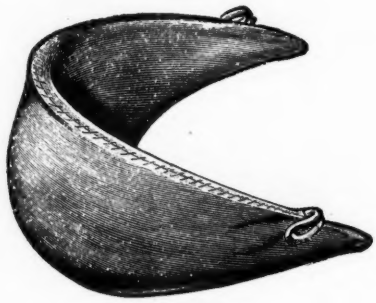

Fig. 11.

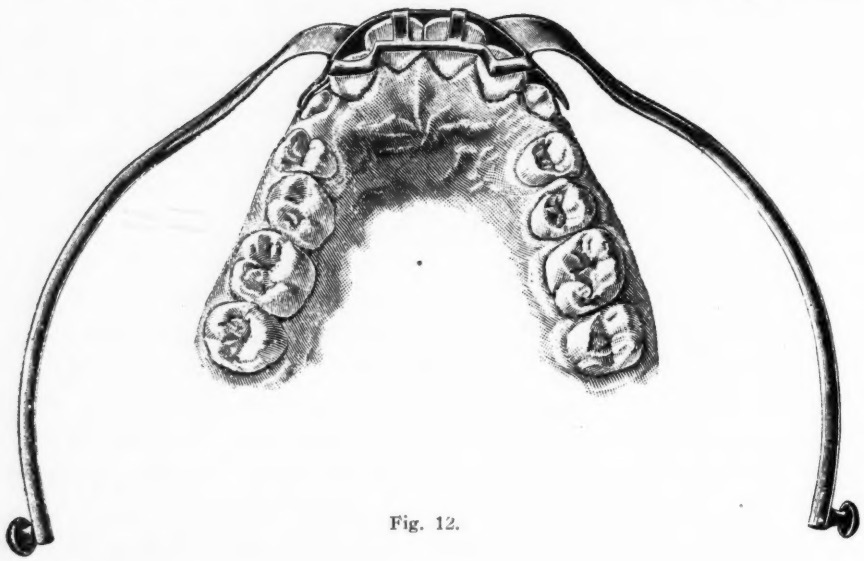

Fig. 12.

skullcap was made of leather; the chin-cap of sheet copper (stiffened around the edge with nonelastic steel wire accurately fitted to a plaster cast of the chin) padded, and covered with leather. When these appliances were in use, an elastic strap cut from rubber tubing passed from the hook near the angle of the chin-cap to the hook marked *A* on the skullcap (Fig. 10) and another similar strap passed from the button at the end of the incisor frame to the hook marked *B* in Fig. 10. The expectations from such an arrangement are obvious. The strain

upon the incisors would carry them directly backward, and the hope was entertained that the pressure of the lower jaw upon the upper at the points of contact would diminish the undue prominence.

"It is worth while here to query whether pressure, being equal upon the lower as well as the upper molars, might not, if it had ever accomplished anything, have done so at the expense of one jaw as much as the other. However that might have been, the fact was that although worn constantly night and day, except at meals, for about three weeks, the chin became so sore under the pressure that we feared an abscess, and it was abandoned. It is doubtful if it served any purpose in closing the gap in front.

"The frame upon the incisors did accomplish in that time all that was desired of it. The incisors, without being lengthened, were altered in their pitch and the cutting edges moved back.

"The reason that this apparatus did not lengthen the incisors in their backward movement was because the strain put upon the crowns was not at a right angle with a line lengthwise through the center of the tooth. The strain was

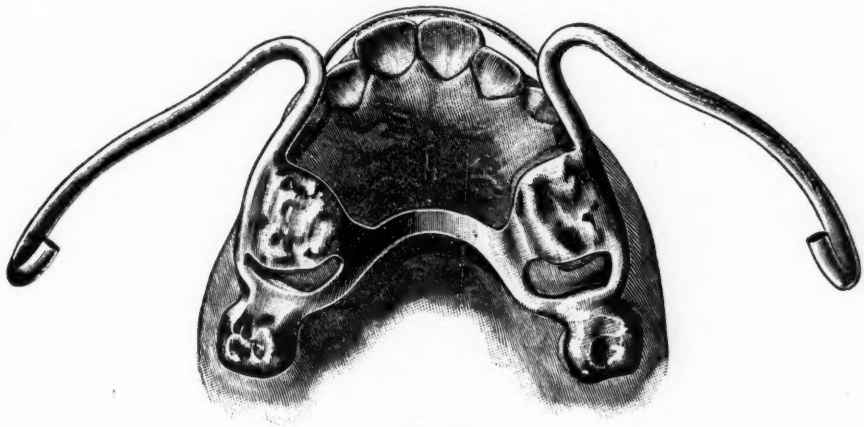

Fig. 13.

at such an angle that the teeth were held in their sockets by a partially upward pressure while the absorption of the process behind them was going on. The distance backward which the cutting edges were carried was ascertained to be eleven per cent.

"The second apparatus, which fully accomplished the work, I ought to have thought of in the beginning, as it is only an application of the principle involved in my interdental splints for the last twenty-five years. It is shown in Fig. 13. A frame covering the bicuspids and molars of the upper jaw, with arms coming out of the corners of the mouth and extending along the cheeks to a point exactly opposite the center of pressure required within the mouth; a small wire passed in front of the incisors to keep them from springing forward, and two elastic straps connected this frame with the skullcap exactly as seen in Fig. 10. Both these elastics were required partly to prevent any tendency of the recently moved incisors from carrying the whole apparatus forward, but particularly to keep the proper balance of the skullcap, the strain of either elastic alone having a tendency to pull it out of place.

"The apparatus is made of one continuous piece of Stubbs' steel forged to follow the buccal faces of the teeth, then pass through the gap made by the extraction of the molars, and cross (without touching it) the vault of the palate to the other side. The bearings upon the teeth were made of silver plate swaged with accuracy to fit the molars, to keep the frame from slipping about, but resting only on the cusps of the bicuspids, thus giving freedom for lateral movement of the bicuspids.

"It was essential that the extremities of these arms should be adjusted with great nicety, so that the force exerted through them upon the offending teeth should be evenly distributed. If the bearing were forward of the center, the apparatus would be loose at the back, and vice versa. This apparatus was applied about the first of March, 1891, and worn almost uninterruptedly without inconvenience until June following, at which time the upper and lower incisors were in contact, the upper ones lapping normally.

"A study of the models shows that the articulation of the molars at the present time is precisely the same as before regulation commenced, and the great

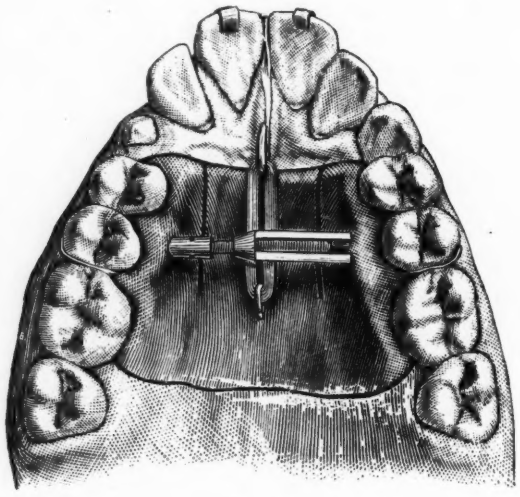

Fig. 14.

change in the front of the mouth is attributable principally to the driving upward of teeth in the molar region the upward and forward movement of the lower jaw, and partly by the incisors being carried back without elongating.

"The plan which I formed to correct this deformity was the result partly of my own judgment, and partly to humor the strong desire of the mother that it should be done, if possible, without extracting any teeth. With that view I decided to attempt to accomplish it by widening the jaw, retreating somewhat the upper incisors, and complete it by 'jumping the bite.'

"The apparatus for that purpose is shown in Fig. 14 and consists of a vulcanite plate and jackscrew for widening the arch, and, acting simultaneously with it, a T-bearing on the face of the central incisors and connected by a rubber strap to a hook in the central part of the plate, as seen in Fig. 14.

"The jackscrew was tightened daily for a couple of weeks, and the jaw

widened about half the diameter of a bicuspid, but the incisors had not moved perceptibly, nor had the widening made an enlargement of the circle sufficient to permit the incisors to be carried back.

"A plate was made of silver covering the roof of the mouth and the teeth. This was made of silver in preference to vulcanite because I wanted as little thickness as possible over the molars and bicuspids, and that thickness to be uniform, so that the interference with the lower teeth in mastication caused by widening the upper jaw might have a tendency to widen the lower one to the same extent. This plate was retained in position by narrow clasps around the molars, and, when fitted, a bite was taken upon it in wax to show the position of the lower incisors.

"The plate was then extended horizontally like a flange or apron in front

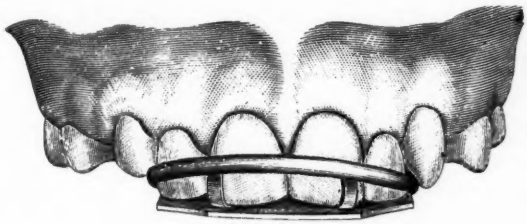

Fig. 15.

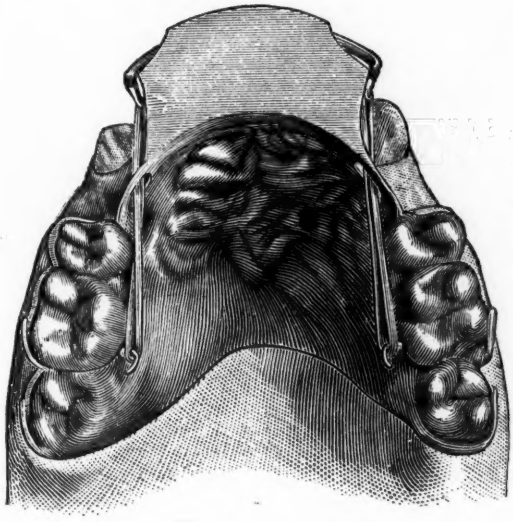

Fig. 16.

of the lower incisors, on a level with and resting upon the cutting edges of the upper incisors. This apron did not interfere with the lower incisors in masticating, as they closed behind it.

"A stout band of gold was made to fit the face of the upper incisors, with a hook at each end, and hooks over the cutting edges to keep it in position. The strain upon the teeth was made with rubber elastics reaching from the extremities of the bar backward, and caught on hooks near the posterior border of the silver plate. This apparatus is shown in Figs. 15 and 16. It needs no argument or description to show that while in use the incisors must be moved backward by the strain of the elastics, and that it was impossible for them to become

elongated so long as the plate was kept in close contact with the molars and bicuspids and this contact was secured by the clasps and by mastication upon it. This is exactly what it did accomplish. It was worn uninterruptedly except for cleansing, and was readily removable (almost too readily) by the patient. The only attention required at the office was to cut off the horizontal flange from time to time as the incisors were retreated.

"An appliance as shown in Fig. 17 was adjusted. It was a vulcanite plate with piano wires, one from each side, meeting and lapping in front, and in their relaxed position standing off for an eighth of an inch from the face of the teeth, but were sprung in and tied to the incisors with waxed ligatures. This vulcanite plate was made pretty stout, comparatively nonelastic, and impinged upon the lingual walls of the bicuspids and molars, for the purpose of assisting nature, which was widening the arch by occlusion with the upper one, and, as from time to time it loosened by those teeth yielding, the plate was warmed and readjusted. A small ring from rubber tubing was also stretched over the three teeth, to assist in closing the gap.

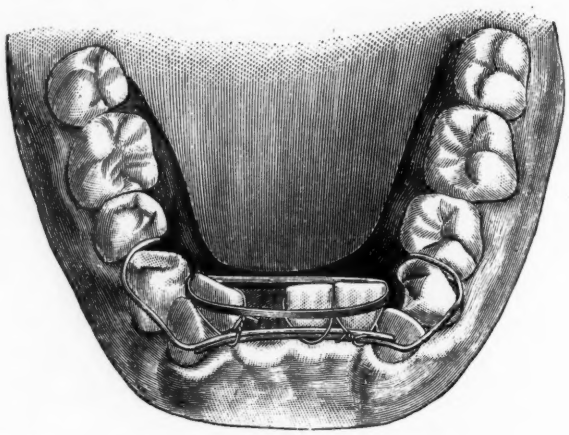

Fig. 17.

"The most singular result of the rearrangement of the lower incisors, and one for which at present I do not attempt to account, is that these teeth have gone down into their sockets not less than a quarter the length of their crowns; they are no longer higher than the natural plane of the lower arch.

"I say that these teeth appear to have been driven into their sockets, but no apparatus worn on either the upper or lower jaw could have had such a tendency; on the contrary, the strain upon them in moving forward would have been more likely to have elongated them than to have shortened them. If we can not accept the idea that they sunk in their sockets, we are forced to the only other alternative, that all the other teeth, cuspids, bicuspids, and molars, simultaneously and uniformly rose from their sockets, for certainty now the plane is not abnormal."

Another appliance similar to Fig. 16 was devised to correct another case and is shown in Fig. 18. Figs. 19 and 20 are the means used to jump the bite.

"The appliance for the mouth, Fig. 20, was a copy of the silver plate already worn, also made of silver, with the addition of arms attached to it pro-

jecting from the corners of the mouth and extending along the face a couple of inches toward the ears. A skeleton skullcap was also made, and connected with the arms by an elastic strap, as seen in Fig. 21. This, as will be seen, was thus acting only upon the upper jaw, and was not originally intended to reduce that undue prominence, nevertheless it did prove of great value in that direction.

"The primary object of this skullcap and its connections with the plate in the mouth was to afford an attachment for an elastic band going under the chin, which should press with only sufficient force to overcome the natural inclination of the lower jaw to drop."

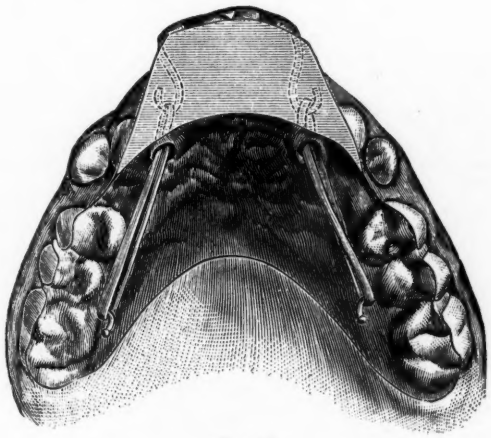

Fig. 18.

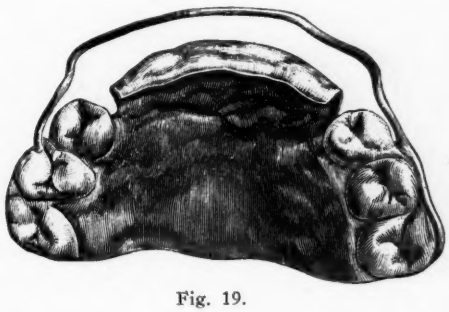

Fig. 19.

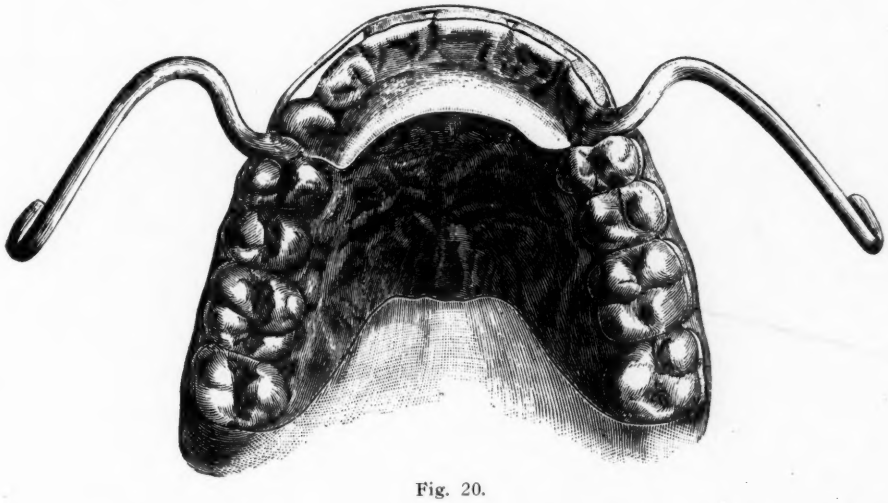

Fig. 20.

In concluding this series of articles Kingsley says: "A moment's reflection will recall the knowledge to any dentist that the lower jaw can be moved forward or backward on the same plane, more than the diameter of a tooth, and this difficulty confronts everyone in making full sets of artificial teeth."

Fifty years after his first article appeared, in a journal we find what was undoubtedly the last Kingsley gave to orthodontia. In a letter to the Alumni Society of the Angle School of Orthodontia, published in the *American Orthodontist,* page 125, he states:

"Gentlemen, Students in the Science of Orthodontia and Fellow-workers in the Art:

"I greet you as colleagues in one of the most interesting and important specialties of medicine.

"If half a century of continued efforts to improve the art entitles one to be called a patriarch, I certainly am a patriarch.

"Some one has said that I am the 'Father of Orthodontia.' I make no claim to that honorable distinction, but for the purpose of this letter I accept the designation and will endeavor to act the part of the counsellor to his disciples.

"This is not a formal address, it rather a 'heart to heart' talk of a father

Fig. 21.

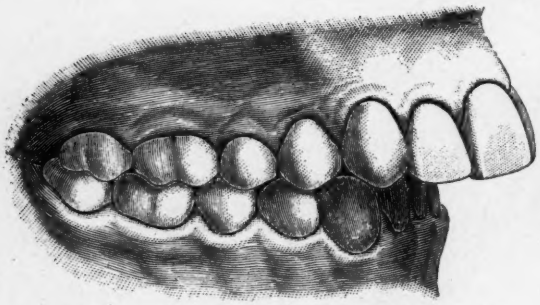

Fig. 22.—The occlusion of the teeth prior to "jumping the bite."

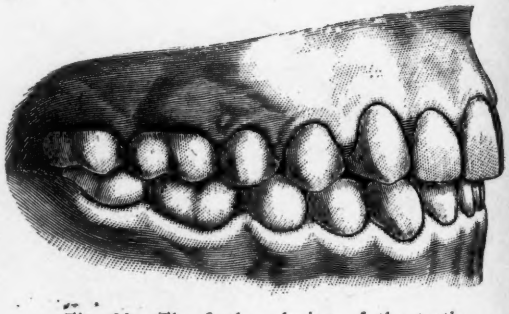

Fig. 23.—The final occlusion of the teeth.

to his sons, who are at the threshold of their careers, for whatever age you may be individually, you are still beginners.

"You are the Alpha, I am the Omega.

"What I may say is not likely to be new to you; at most I can only refresh your minds upon things you have already learned—much may appear common-place and obvious and will command your respect only because common-places when hoary with age are frequently counted as wisdom.

"Fifty years ago there were no orthodontists. There was no orthodontia. We were not practicing a science, we were just straightening crooked teeth and making them even in the arch. We had no settled system and therefore it was not entitled to the distinction of a science. It may be that the term had been

coined before that time, but if so, it was not in common use and indeed now it is not to be found in some of the most modern dictionaries.

"We were empirics—experimenting, inventing and trying out our plans. All science begins in empiricism and orthodontia as a science was founded in empiricism. I think your Dr. Angle has been one of the greatest empirics of his day—mind you, not a charlatan, but an experimenter, and out of his empirics he has forged a system of related facts, and thus his empiricism has contributed to create a science.

"There could have been no greater empiric for thirty years or more than I, myself, for during all that time I was constantly regulating teeth and without any previous experience of others or any knowledge except that gained by experience. I was devising new ways to meet every emergency.

"You young gentlemen have a great advantage. Your brains are not taxed by conceiving new experiments and trying plans that end in failure. You have a formulated science and proved system to guide you in almost any conceivable emergency. I congratulate you—you start your careers without the handicap of ignorance, and wonderful possibilities lie before you.

"I want to impress upon you a few things as a father out of a father's experience. Start fair—begin right—don't take a second step until you are perfectly sure that your first is correct. Study your case from models as well as the oral cavity, but be sure that you have perfect models. Be sure of a good impression—no matter what material you use. Do not be guilty of the solecism of showing an imperfect cast and apologizing for it by saying that the impression was taken in a hurry. Be honest and own up that it was the best you could do.

"Of all things, this step must not be hurried. Better none at all than a hurried, defective one. If your time will not permit, then postpone the setting. Don't begin this most wonderful branch of technical scientific art with a false start. Let exactness be your dominating motive—exact in every step and each succeeding one will be attained easier and the end a triumphant success. Except in the very simplest cases, make and keep good models of your cases properly occluded and articulated. It is better that you connect your casts at the heel either by a hinge or guide-pins and thus preserve the occlusion from being bruised by handling.

"Preserve with care for study and future reference the first casting from your impressions and be particular about the appearance of these models. Appearances go a long way to support assumptions. I think in times past my colleagues have been more impressed by the symmetry of my models than by all my talk. Talk is cheap—anybody can talk, but it is not everybody who shows neat, carefully prepared, artistic models.

"Fine models, without any talk, carry more conviction than all the oratory with a display of unsightly plaster casts. Many times I have seen an exhibit of dirty casts, apparently rescued from the ash-heap, which challenged attention only by their number and shabbiness—casts exhibited to illustrate some phase of orthodontia, devoid of articulation, only as held in the hands. Casts that so far as accuracy went, might have been mismatched and almost reversible. A lot of teetering, wabbling models with the cusps rubbed off to such an extent

that one could prove almost anything by them. Such models prejudice the standing of orthodontia more than they advance it, while on the other hand, beautiful models not only command the respect of your colleagues, but are an ethical form of advertising to your patients both justifiable and commendable.

"It it not so difficult to straighten crooked teeth. The requirements for bringing into proper relations and alignment have been in a great measure anticipated and appliances have been developed until a system of general application is at your command. In the present advanced state of mechanical apparatus, it is not a difficult matter to get the dental system into a position acceptable to your patients and yourself, but to hold it there until it becomes permanently settled is a much more serious problem. It is the *one important consideration* in all your prognosis. *The success of orthodontia as a science and an art now lies in the retainer.* The perversity and contrariness of inanimate things is proverbial and nowhere more strikingly exhibited than in the effort of nature, when forcibly diverted, to return to its former condition. Again, what we call nature, seems frequently more disposed to go awry than right and here nature is seconded by the impatience of the subject, who, having gone through a period of prolonged strain, encouraged by the progress and by the expectation of benefit and satisfied with the accomplishment, feels any continuance is a hardship. Too often has the victim been left in a worse state than before the beginning; gains have not been fixed, the work must be renewed and between the see-sawing of advance and retreat a nervous system is shattered which will take a life-time to recover.

"The ideal, universal retainer has not yet been devised. I warn you, therefore, with all the solemnity of a patriarchal experience, do not discharge the case or abandon retainers until there is reasonable expectation of permanence. You may rightfully ask of that experience, 'How long will that be?' Your patient will pester you with the same query. Out of the same observation and experience, I can only answer—I am agnostic, I don't know. In each and every individual case, I don't know. It took a long time to go wrong, it will have to be held a long time to overcome the tendency to retreat and particularly if the malposition seems to come from an inherited tendency, not a settled inherited deformity, but a predisposition which can be obliterated by correction and its transmission aborted. Settled transmitted deformities become permanent types.

"I want you to realize that in adopting this specialty you must be something more than a mere mechanic. One who, like the plumber, has been taught his trade and can do only those things that he has learned and do them in no other way. You must become an artisan and apply brains to your mechanics, but more than that, if you meet all the possibilities of benefit to your clients, you will encroach upon the domain of the artist, which involves the highest order of mechanical achievement. This is an extravagant Utopian claim or expectation. The altruist can reach no higher ideal than you in fulfilling the requirements of your vocation. You not only make your patient physically better, but you contribute to his self-respect and to his beauty. Within limits, you can transform a face

from inharmony of feature to symmetry, from ugliness to comeliness, and from a repulsive expression to a winning one.

"A few years ago a gentleman whom I regard to be the most distinguished representative of intellect and culture that America has ever produced, a veritable giant in attainments, said to me: 'I want to thank you for what you have done for my son. You have transformed him with an ugly face and made a right handsome boy of him.'

"In the effort to become artists in orthodontia as well as artisans, do not let sneers or ridicule affect you. Forty years ago I was lecturing to a class upon these general lines when I encountered in print, from the pen of a dental editor, who was likewise a college professor—referring to my lectures, he wrote: 'Whose art is some plaster casts and his lectures maudlin sentiment.' Was it maudlin sentiment? Forty years have passed, but I may be permitted to say that the name even of that professor is forgotten while the 'maudlin sentiment' has become a part of the advanced teaching of orthodontia.

"Bear in mind that you are engaged in a profession, not in a trade. The education, culture and customs of civilization all accord superiority to the learned professions and require that they be conducted with dignity and in a manner to avoid reproach. There is an unwritten code of ethics among honorable men which you will not violate, but while your vocation is beneficent and humanitarian in a large sense, it is also a business and must be so conducted as to bring a remuneration equal to a similar education and ability in other occupations in your environment. You are entitled to fees that will maintain your social standing with the better class of your neighbors. You must get these fees by your recognized skill. You must obtain patients on your merits and not under any circumstances by offering or paying commissions to any one whatsoever. Commissions offered to a professional brother mean bribery, detested by all honorable men. Commissions exacted are equivalent to the demand of the road agent of the plains—'stand and deliver.' Commissions paid by you mean cowardice. You yield to a 'blackmailer' under the threat of injury. You yield to the demand from your professional brotherhood under the implied threat of a loss of bread and butter. It is nobler to go hungry than buy bread at the sacrifice of professional dignity and honor.

"In all my fifty years of experience I never offered or paid a commission to any man and I was constantly receiving patients recommended to me by dentists. If your fellow-practitioner can not treat the case properly and feels that he can not afford to let it go without remuneration, find some other way of recompensing him than by vulgar coin. Send him some patient that his ability can master and thus establish reciprocity. I believe in reciprocity. Let him have all the fee without rebate that the patient is willing to pay. Let it be a matter entirely between themselves. This does not refer to business arrangements that you legitimately make with an associate or an assistant upon a division of the fees, for in the latter case he becomes, in the eye of the law, a partner; the arrangement is a legal co-partnership and will stand the test of the courts.

"You are filling a most important place in the world's work. You are making people more comfortable and incidentally improving the race. In the

very best sense you are a humanitarian and an altruist. It is right that on all proper occasions you magnify your vocation, but don't get bumptious or conceited. Your calling is exceedingly limited in its influence on mankind as contrasted with men of large affairs. The captain of industry is master and director of enterprises that benefit the masses and contribute to the progress of civilization. Yours is limited to the invididual, therefore put forth your claims to recognition with becoming modesty and thus command respect for yourself and for your science.

Lives of great men all remind us,
We can make our lives sublime,
And departing leave behind us,
Footprints on the sand of time.

"Warren Point, New Jersey, December 3, 1908."

Isaac Woolworth in the *Dental Cosmos,* November, 1865, page 189, under *Treatment of a Case of Irregularity of Teeth* says: "I took an impression of the entire jaw and teeth, as far back and including the six-year-old molars, and made a plate or cap of hard rubber over all the teeth, not, however, covering the palate to a very great extent. I placed a quantity of plaster on the cast in front of the deflected teeth, so that the plate would arch out at those points, and filed the plate so as to expose the cutting edges of these teeth about half their height. I then drilled two holes opposite each tooth I wished to move, tied some strings of strong cotton thread around each, and passed the ends through the holes and tied them fast. I renewed the strings daily for four weeks, and dismissed the case perfectly corrected, with instruction to wear the apparatus in the same manner, except in tightness, four weeks and longer, if the teeth inclined to fall back. The advantages of this fixture are in its simplicity, the ease in which it is worn, the constancy and uniformity of the tension, the certainty of keeping the jaws asunder so as to insure the transit of the deflected tooth over the under tooth, the ease with which it is adjusted from day to day, and it causes no soreness to the gums."

Thomas C. Vidler in the *Dental Review,* April, 1864, on *Treatment of Irregularity of the Teeth—A Case in Practice,* says:

"I commenced operations on the lower jaw by moving the lower front teeth outwards, employing for that purpose, a plate of vulcanite, into which was inserted pegs of compressed hickory wood, so arranged behind the teeth that the pressure of the wood moved them forward in the required direction. Attention was given at least twice a week to the progress of the case, and at the end of a month's time a considerable improvement had taken place, and a second plate became necessary. This was adapted in like manner as before, and in another month I had accomplished all I desired with the lower teeth.

"A thick vulcanite plate was constructed to fit close behind the teeth. Pressure was first applied by means of compressed wood to the lateral incisors and canines, and subsequently to the bicuspids. At the same time the position of the front lower teeth was considerably improved by the force exerted upon them by the great thickness of the plate behind the teeth, which, forming an

inclined plane, continued to press them forward in the required directions. This appliance was so far found to answer the purpose, that it was worn without discomfort, and retained in position without inconvenience. The wedges of compressed wood were regularly changed every second day for a period extending over several weeks, and subsequently about every third day. Three plates were required for the upper, before the teeth were brought into position."

T. Burgh in the *Dental Cosmos* under the *Transactions of the Brooklyn Dental Association,* January, 1867, page 420, introduced the subject of the evening, *Regulating Teeth,* explaining his method as follows:

"The object was not only to regulate these teeth, but to expand the roof of the mouth and increase the size of the arch, and without extracting any teeth. The method employed is as follows:

"A cast is obtained from a wax impression. The teeth and the surfaces of the roof of the mouth to be acted upon are cut or scraped away to an extent equal to the amount of space which it is prudent to move the teeth at one time. The plate is then inserted in the mouth, the patient is directed to exert force upon it with the lower teeth, which forces it up into the roof of the mouth—expanding the arch in whatever direction the force is applied. In this case every tooth was operated upon at the same time—some more and others less—and also the roof of the mouth in every direction except upward. As soon as the teeth have yielded, the plate will begin to operate in the roof of the mouth. It will operate here more slowly, as the force has to reach the maxillary bones through the yielding gum. The gums will sometimes become inflamed, but if the cast has not been cut too much, this will pass away as the bones expand. Care should be taken to have the plate antagonize with the lower teeth, so as to produce a uniform and steady pressure. It is not well to cut the cast much, in order to get more work out of each plate, for the plate will not work as well as though the cast were cut moderately. He generally cut his casts the thirty-second or the sixteenth part of an inch.

"As soon as one plate has done its work, a new impression should be taken, and the process repeated.

"After the arch had been expanded considerably, he commenced to turn the three incisors. This is done on the same principle as that on which the arch is expanded; viz., by cutting away the plaster teeth in such a way so that a rubber plate made to the cast will produce a twisting pressure on the natural teeth. The same kind of plate is used for this as for the former, but with the difference that the plate runs over the cutting edges to be acted upon, and on to whatever portion of their labial surface is to receive a pressure. Before making the plate, an amount of plaster is moulded on to that surface of the tooth which is opposite to that which has been cut, to leave room in the plate for the tooth to move."

E. A. Bogue, in the same journal described the following method:

"A gold plate covering the roof the mouth, attached to the molars; from the clasp, between the first molar and the bicuspid, a thick bar ran outwards three-sixteenths of an inch. A piece of clasp metal was bent to fit around the

circle of the upper teeth, reaching from the space between the bicuspids on the one side to the same point on the other; the two ends of this band were bent outward at right angles with itself; in front, opposite the incisors, some small strips were soldered and bent into hooks over the cutting edges of the incisors, to prevent the band from slipping up against the gums. Holes being now drilled through the two outward bent ends of the band, and also through the two projecting studs in front of the molars, and screw threads being cut in the latter, it only remained to insert screws in their proper places to complete the apparatus. A few turns of the screws each day sufficed in a few weeks to draw the teeth inward to such an extent, that from a picture sent him some time afterward he should not have known of the previous deformity."

A BAND RING

By Carl O. Engstrom, D.D.S., Sacramento, Calif.

A SIMPLE band ring with a wide range of usefulness in orthodontic treatment is herein illustrated and described. By the proper application of ligatures and an arch wire it is possible to move teeth in any direction or a combination of the same, so it is with the band ring which is often advantageous. The means employed is always a matter of knowledge, judgment, and skill on the part of the operator. This ring differs from the ordinary ring with its one-point attachment to the band in that a more secure attachment is provided with

Fig. 1.

Fig. 2.

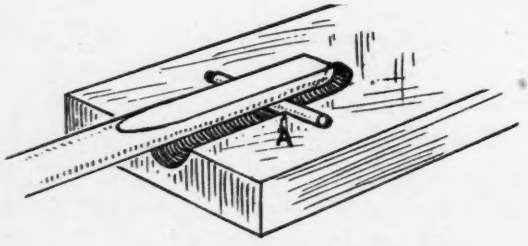

Fig. 3.

a minimum amount of material and a more efficient application in use is afforded.

In Fig. 1 is shown a small piece of wire used in the making of the ring. The flattened ends allow for the wire being easily positioned on the band and gives a sufficient surface for attachment in soldering. It will be observed that the wire is of such form that it can be held with pliers. Fig. 2 shows the wire soldered to the band. Sufficient solder is used on the surface of the band to form a round hole of the wire. The solder while filling the angles made by the

wire and band surface adds to the strength of attachment. More solder than is shown in the illustration may be used and a more exact hole can be made with a small burr. After soldering, the rough ends of the wire may be made smooth with a small stone and then polished. It will be noticed that a firm attachment is provided, and that a wire placed in this ring is in close proximation with the band, affording and facilitating an exact adjustment. This also applies to a tube made of metal plate in like manner.

For those desirous of shaping wire to make these rings, I will describe the die which I used and which is illustrated in Fig. 3. A groove was first made with a thin carborundum disk in the end of a drawplate. A transverse groove was then made for the reception of the wire. This was done with a small burr and stone. While the transverse groove may not be necessary, notches should be made in the plate at *A*, Fig. 2, that the wire may be formed so as to provide for the angular spaces (Fig. 2, *A*) which are filled with solder in the soldering. A small steel wire flattened a little with a file is the male part of the die. With the wire positioned as in Fig. 3, a large hammer is used to seat the steel wire, shaping the wire for the ring and flattening the ends. Wire .020 gauge and about an eighth of an inch in length may be used for the ring. However, any size to suit the case may be employed.

A LOOP-WIRE SPLINT

By Harry P. Beaser, D.D.S., Fresno, Calif.

TO orthodontists, the loop alignment wire has proved to be practically indispensable. The loop principle is used in many different forms of appliances for treatment of malocclusion. The use of it, however, does not stop with orthodontics. It can be applied successfully by oral surgeons in the reduction of fractures of the maxillæ and mandible. The cuts here shown exhibit the second of two cases which have been referred to me for treatment, by a general surgeon.

The splint was first sought out for its rigidity, in order to relieve the patient of the necessity of having the jaws locked together by the usual means to insure a good occlusion, and the loop was added to the wire for the purpose of adjusting the broken parts to their normal position.

Fig. 1 shows the appliance as it appears out of the mouth, and Fig. 2 shows it in position on a plaster model, the black line on the model indicating the position of the fracture in this case.

The construction of the splint is very easy, and if it is possible to have the patient come to the office, the entire work will not take more than an hour or so. Two plain bands are fitted to teeth on each side of the fracture. It is best, however, not to band the two teeth approximating the fracture, as they are usually very unstable and would not give the necessary support. There is also a danger of causing irritation at the point of fracture.

The lap-joint band is much better than the ordinary pinch band for the

molar teeth, but all bands should be made to fit rather loosely so that they will slip on and off easily during the construction.

The two bands are soldered together with a short piece of 16-gauge wire. Free-hand soldering can be done and should be, to avoid taking impressions which are painful to the patient and usually quite inaccurate at best.

The short tie-wire would in most cases, be placed lingually with the long loop-wire labially, but if the conditions of the surrounding tissue interfered, the order could be reversed.

The best way to measure the wire accurately, is to solder one end to the distal band, and then mark its position on the other band with a sharp instrument. After soldering to the second band, any slight adjustment necessary can be made with the pliers or wire-stretchers.

When both sets of bands are soldered and replaced in the mouth, the loop-wire is then made. Sixteen-gauge wire is sufficiently large for the average case, but if deemed necessary, a larger gauge could be used. Anything smaller, however, would be likely to spring, if the muscular force was very strong.

The loop is placed in the wire at a convenient point, but should be as near the line of fracture as possible to permit a little finer adjustment at this point,

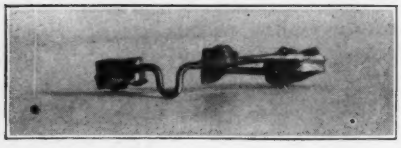

Fig. 1.

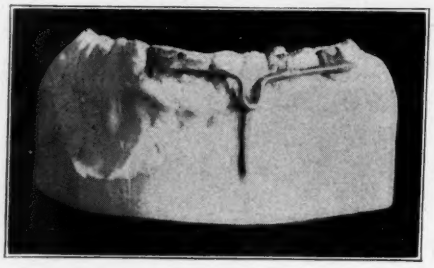

Fig. 2.

especially if the break occurs in the canine region. The two broken parts of the bone can be held together and the loop-wire bent and cut to approximately the right length and shape; then, as before, solder the distal end to the distal set of bands. Figs. 1 and 2 will show this very plainly. After this is done, place the bands in the mouth and mark on the anterior set of bands the approximal position of the anterior end of the loop-wire, remove all from the mouth, and solder. The appliance is now ready for finishing, and after smoothing down all rough corners, etc., is ready to cement. This can be quickly and easily done with the aid of the assistant or without an assistant. Any one familiar with cementing more than one band at a time will find little difficulty. After a sufficient length of time has elapsed to permit the cement to set thoroughly, the finer adjustment can be made. I have found that 16-gauge noncorrosive wire thoroughly annealed, possesses the best qualities for adjustment and rigidity.

Grasp the loop firmly with a strong pair of pliers and draw the parts together, at the same time forcing the teeth into their proper occlusion. The loop allows of movement in any direction and the wire will hold the parts in this position without further assistance. All bandages can be removed and the wiring together of both jaws will be found unnecessary except in very extreme

cases, such as bad complex and multiple fractures, and not always in those. The advantage the loop splint has over other jaw splints is that it will perform the service necessary with the least amount of material. The inconvenience to the patient is no more than that felt by any patient wearing an orthodontic appliance, and a more complete prophylactic care can be given.

The patient can talk and eat with practically as much ease as before meeting with the accident, and no unsightly bandages, etc., are necessary.

Fig. 3 shows the splint in the mouth directly after cementing to place, and Fig. 4 the same after adjustment. Note the occlusion of the teeth. This case was the result of an automobile accident in which the patient suffered quite a number of other bruises and broken bones, but a few hours after the adjustment of the loop splint, practically all pain had left this region and the fact that he

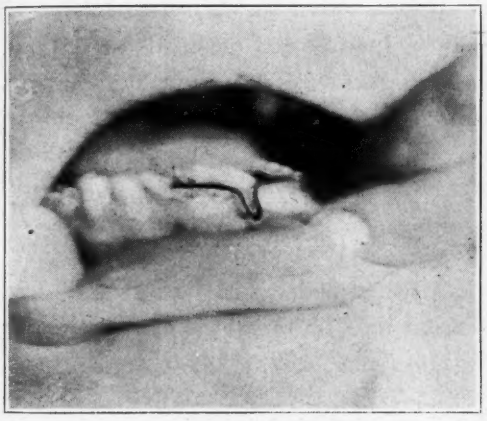

Fig. 3.

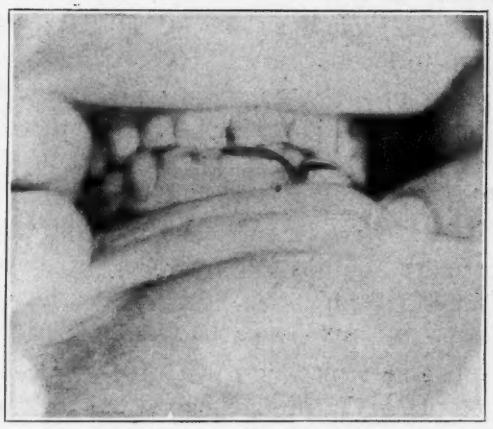

Fig. 4.

could eat a good meal, smoke a cigar, and talk, gave him a brighter view of life and materially hastened his recovery.

Many forms of splints have been invented from time to time, and the necessities of war have brought out many more near the battle front or in the base hospitals of Europe. The use of metals for this purpose has superseded all other materials as it is much more efficient and cleanly and permits the muscles of the mouth to remain in their normal position of rest without strain.

It is reported that some of the English surgeons in France have placed bands either side of a fracture with long wires soldered to them that overlap, and when the fracture is set, the overlapping wires are fastened together with soft solder in the mouth. The results of this method are probably efficient, but must necessarily be very rough and hard on the patient.

By using the loop-wire instead of the above, the splint could be constructed as quickly and with more satisfactory results.

ENDOCRINODONTIA, OR THE DUCTLESS GLANDS—THEIR EXPRESSION IN THE HUMAN MOUTH

By Herman E. S. Chayes, D.D.S., New York City

PART I

THERE are many people who are perfectly well; their daily life is often one of intense physical and mental activity, and yet they rarely, if ever, require therapeutics or mechanical attention. There are others who are miserably ill, mentally and physically, their daily life is one of continued attempt to guard against further encroachment by disease. They are continually under the care of some one ministering to some of their ailments successfully or otherwise. Some people for a period of time are perfectly well, then, for some obscure, and to most observers, unaccountable, reason, sicken or fall seriously ill, to recover in the same obscure and unaccountable manner and continue to live and to work, without further interference from disease, for their allotted number of years.

In corollary with the above, there are many people whose dental apparatus is in perfect balance, mechanically expressed, in perfect occlusion, who never require any dental interference; still others whose teeth were in imperfect condition, as expressed in malocclusion, have had them placed in balance, and subsequently require an incessant amount of dental interference to keep on repairing and replacing parts of the continually breaking down apparatus. Some people never pay any attention to the cleanliness or the environment of their teeth, and yet they never need to, nor do they seek dental interference for the alleviation of any dental disorder. There are others who are constantly having their teeth cleaned, their roots scraped and their gums scoured, and still their teeth continue to present new cavities, new breakdowns, new dystrophies.

Manifestly, the correction of bodily health and tooth health is not clearly understood.

Many physicians, many surgeons, many dentists will readily admit the truth of the foregoing and attest to the statement that they are and have been constantly on the alert for some thing, some truth, the understanding of which would enable them to more effectively handle and efface bodily disorders.

May it not justly be said, right here, that the cause of medical and dental ineffective ministrations has been due to the classification of cases of patients in the aggregate under the heading of certain diseases, when we should have devoted our attention to the close study of the individual constitution of each patient, and so learn to treat an aggregate malady in an individualized way.

It is a fact that the same disease will express itself differently in different individuals, and yet, if we take up our works on therapeutics, we shall find a woeful lack of individualization of cases calling for treatment.

Under the heading of "Pneumonia," the pneumonia is treated, under the heading of "Diphtheria," antitoxin is advocated. Tuberculosis has its prescribed order of treatment, etc. It is always the disease, almost never the patient.

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We have become so obsessed with the pathologic anatomy of the case that we fail to recognize the ever receding voice of God in the individual, struggling with all the normal that is in him, to overcome the very picture we take as a guide to our treatment. It is so in dentistry, we see the teeth of children decay, and we either remove the teeth and disturb the arch; or we fill the teeth which have decayed, and allow the child to go with the predisposition to decay in the constitution, unrestricted to work its further havoc.

We see a case of so-called traumatic occlusion and we begin to file and grind the teeth into more or less acceptable stress relationship, paying no attention to the particular "ism" in that particular constitution which caused the arrangement of teeth ultimately bringing about the traumatism that sent the patient to us in search of relief.

A woman becomes pregnant, bears and gives birth to a child, many of her teeth begin to decay, she loses one or two of them, during the period of lactation, she seeks our advice and help, and we dentists, in almost every instance, fill the decayed teeth and replace the lost ones and dismiss her to go through the same dental ordeal, should she be called upon, in her relation as a wife, to again become procreatively active.

A case of pyorrhea presenting for relief, the patient is either pyrocided, vaccinated, scaled, scraped, scalded, rubbed and drugged locally, a few teeth are lost, being too far gone; a few are filled, not far enough gone; a few are crowned with golden caskets and the bill paid, the patient is allowed to go and take the pyorrheal potential in his or her constitution, the attack recurs with renewed virulence and renewed destruction.

Time to change about it seems to me, time to realize that we have not been dealing with the fundamental facts of the cases in our treatment of diseases.

All the bacteriology we know has not enabled us to eliminate effectively diseases the bacteria of which we know best and are most familiar with.

Time to realize and to profit from this realization that there are, for example, any number of individuals to whom we could feed sandwiches made up of bread and pneumococci and who would be none the worse for the diet. This is equally true of all germs, not excepting the most virulent of streptococci.

Some people's teeth will not decay in spite of the lack of any attention on their part or the dentist's part.

Some people need but the least exposure to contract all sorts of diseases. Some people's teeth decay in spite of all attention. Some children never have any infectious diseases, some have all sorts of afflictions.

Wonderful resistance in the apparently immune specimens, lowered resistance in the others. Yes, my friends, but what is this resistance? Why are some possessed of it and why not the others? Where do they who have it get it, and what do those who suffer lack, in order to make it?

Patients have become habituated to seek a physician so he may see the disease. Physicians should become habituated so that when they look at and for a disease they should see the patient.

Patients have become habituated to go to the dentist so he may look at and after the teeth.

Dentists should become habituated so that whenever they look at a tooth decayed or healthy, they should see the patient.

All this does not mean revolution, neither does it mean a reactionary program, it simply means a broadening of our vision, a more comprehensive understanding, and hence a more effective service in our field of endeavor.

The endocrines are the organs of internal secretion.

Endocrinology is the study of the organs of internal secretions and the study of the functions of these organs.

Secretion is a specialized function of certain glands made up of highly specialized epithelial cells (secreting cells) in the exercise of which function, they take up substances from the blood stream and elaborate these substances into products wholly at variance in appearance and effect with the substances which were taken up, and discharge these products by the avenue of special channels or ducts into various organs of the vegetable, animal, or human anatomy, to effect the physiologic expression of these organs.

Internal secretion may be defined in the same terms, except that there are no special channels or ducts through which the products elaborated by the ductless glands are conveyed to the various organs; so that these products may be said to find their way into the various parts of the body by directly entering the blood stream.

The products of the ductless glands or glands of internal secretion have been termed hormones from the Greek word, to excite.

Their influence upon the functions of the various organs of the body is one of augmentation or excitation and, under some circumstances, one of inhibition.

The potency of these products is practically independent of quantity and wholly interdependent as to quality. In this respect, they are very much akin, if not wholly like enzymes or ferments.

They are in such a fine state of subdivision that they may be likened to electroatomic messengers communicating and carrying orders or directions or aid from the vegetative centers to all parts of the body with which they communicate at all.

The most important ductless glands as we know them are, first the pineal, a small gland situated at the base of the pituitary body.

Second, the pituitary body, a very vascular gland, consisting of an anterior, middle and posterior portion, all situated in the cella turcica of the sphenoid bone. Governs periodicity, rhythm, influences growth, nutrition, reproduction, the psychosis, and is influenced by the thymus, the thyroid, the gonads, and the adrenals.

Third, the thyroid gland and the parathyroid bodies. The first consists of two lateral lobes, disposed on either side and in front of the larynx and upper three or four rings of the trachea. The parathyroid bodies are arranged on either side of the median line and may be found as low as the seventh tracheal ring. The thyroid is a very vascular body of gland tissue, it is supplied by the superior and inferior thyroidal arteries, which form a rich anastomosis. The veins are correspondingly free and numerous, they are valveless and empty into the jugular and innominate veins. Influences nutrition, growth, reproduction and is profoundly influenced by functional and organic disturbances of the alimentary canal and the gonads.

Fourth, the thymus develops as a paired sac-like diverticulum of the ventral portion of the third and fourth and possibly the second pharyngeal cleft. This sac-like beginning of the thymus is entirely epithelial in structure. Influences metabolism in the child, also the thyroid, the pituitary and the gonads, and is itself markedly affected by pituitary and adrenal disturbances.

Fifth, the suprarenal capsules, adrenal bodies, are two small, flattened, glandular bodies located in the back part of the abdomen, above and somewhat anteriorly to the upper part of each kidney. They consist of a corticle and medullary portion, they are exceedingly vascular, with abundant lymph supply. The nerve supply is significant, being derived from the solar and renal plexuses and getting branches from the phrenic and pneumogastric nerves. Their important connection with the sympathetic is today well known. Dr. Joseph Fraenkel terms the sympathetic nerve "the frozen adrenal" attempting to convey the impression that it is a continuous line, icicle as it were, of projected adrenal substance. The adrenals play a most important part in the development of the being; a tremendous part in the mental growth of the being. Virtually, the great center of the anatomic nervous system, they have been called the abdominal brain, they control energy and the decorative scheme in the body; they have everything to do with pigmentation, with oxygenation of the blood; they influence the thymus, the thyroid, the pituitary body and the sexual organs, and are themselves markedly affected by thyroidal, pituitary, and gonadial influences.

Sixth, the gonads, the organs of immortality on the procreative plane or better, the instruments whereby man perpetuates his species on earth. In children the gonads are markedly influenced by the thymus, the persistency of which will retard adolescence. In children of normal development, the thymus goes out at puberty and the thyroid with its regulating and supervising influence comes in. At that time also, the assertive period of the gonads becoming manifest, they call on the adrenals in the male and on the pituitary in the female to set up an intercommunicating system of harmonic relations, which result in a most intimate interdependence, very apparent in the female during menstruation, pregnancy, childbirth, and lactation, in the male during periods of great physical stress, excitation or copulation or of sublimation of the procreative urge into intellectual or intuitional poetic expression, in other words during inversion of procreation to creation.

The foregoing may be summed up rather crudely as follows:

Thymus—Youth.
Thyroid—Quality and equilibrium.
Pituitary—Bulk and disposition (psychosis).
Adrenal—Energy and decoration.
Gonads—Immortality or procreation.
Pineal—Intelligence, soul or cosmic relationship (?).

The normal, augmented or inhibited activity of one or more or all of these glands is manifested in diverse ways in the human, dental apparatus, and it is to the recognition and the study of these manifestations, that I have given the name of "Endocrinodontia."

The thymotrop, the thyrotrop, the pituitotrop, the adrenotrop and the gonadotrop are names or designations appended to individuals who exhibit in their makeup, a preponderance of thymic, thyroidal, pituitary, adrenal, or gonadial influences, as the case may be.

(To be continued in April issue.)

DEPARTMENT OF
DENTAL AND ORAL RADIOGRAPHY

ANATOMY OF THE TEETH AND JAWS, WITH SPECIAL REFERENCE TO ROENTGENOGRAM INTERPRETATION

By Robert H. Ivy, M.D., D.D.S., Milwaukee, Wis.

Major, Medical Reserve Corps, U. S. A.; Associate Surgeon, Columbia Hospital, Milwaukee; Formerly Instructor in Oral Surgery, University of Pennsylvania

IN the passage of the roentgen rays through the tissues, the denser the tissue the greater the obstruction offered to the rays, and consequently the lighter will be the image in the negative.

In roentgenograms of the jaws, the substances depicted in the order of their density, beginning with the densest, and therefore the lightest in the negative, are:

1. Metallic crowns and fillings, and root canal fillings containing zinc or other metals.
2. Enamel of the teeth.
3. Dentine.
4. Cementum.
5. Cortical bone.
6. Cancellated bone.
7. Medullary spaces, canals, foramina in bone, and soft tissues.

In disease, the normal condition of a given tissue may be changed either to a lessening in density, meaning abstraction of lime salts, with consequent deepening of the shadow in the x-ray negative, or an increase in density, due to a deposit of lime salts, and indicated by a lessening of the shadow.

A familiarity with the anatomy of the teeth and jaw bones is one of the fundamental essentials for correct interpretation of roentgenograms. Lack of this knowledge is frequently a cause of mistaking of normal shadows for manifestations of disease.

The teeth are set in sockets in the alveolar process, being attached by the peridental membrane. The alveolar process is composed of spongy or can-

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cellated bone (Fig. 1), which appears in the roentgenogram as a fine interlacing network. The sockets of the teeth are lined with a thin plate of dense bone, which is shown in the x-ray negative as a fine white line around the tooth. Between this line and the tooth itself is a narrow dark space representing the peridental membrane. *These lines are important landmarks in the interpretation of roentgenograms, as their absence or deviation usually means some pathologic condition* (Fig. 2).

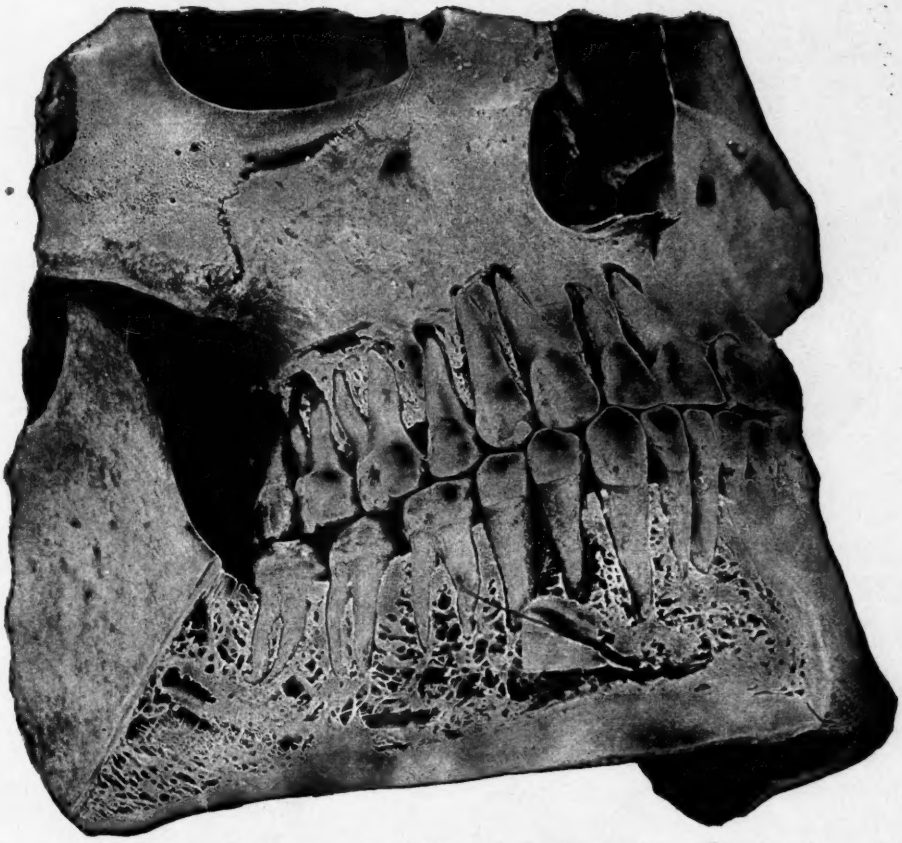

Fig. 1.—Showing cancellated bone of alveolar process. (Cryer.)

Fig. 2.—Upper right central, lateral, and canine. Pulps vital, no periapical abnormality. Floor of nose and maxillary sinus barely shown as dark shadows above. The thin dark peridental line and dense white bony line are seen about roots. Fillings shown as dense white spots.

ROENTGENOGRAPHIC ANATOMIC LANDMARKS IN THE UPPER JAW

At a varying distance above the apices of the central and lateral incisor teeth is found the *floor of the nose* (Fig. 3), sometimes seen in the roentgeno-

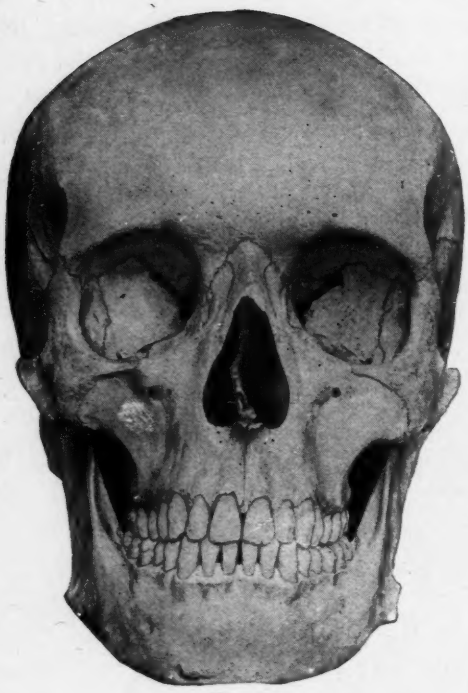

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3.—Anterior view of skull, showing anterior opening of nasal chamber. (Cryer.)

Fig. 4.—Upper right central forms abutment to poorly fitting bridge, which extends to left canine. Upper left central and lateral have been lost. No periapical abnormalities. The dark area above is the nasal fossa.

Fig. 5.—Upper right lateral incisor shows post for support of crown, no other root filling. Ill-defined dark area about apex due to chronic rarefying osteitis with suppuration. Nasal fossa with inferior turbinate well shown above.

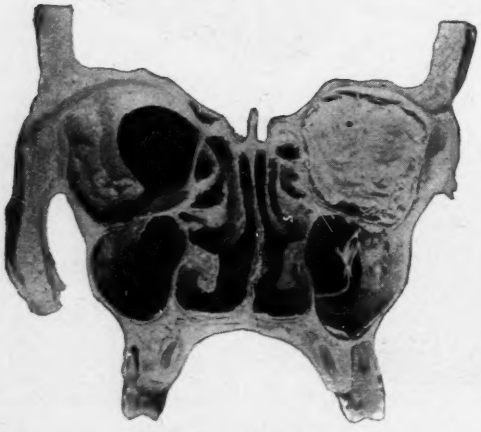

Fig. 6.

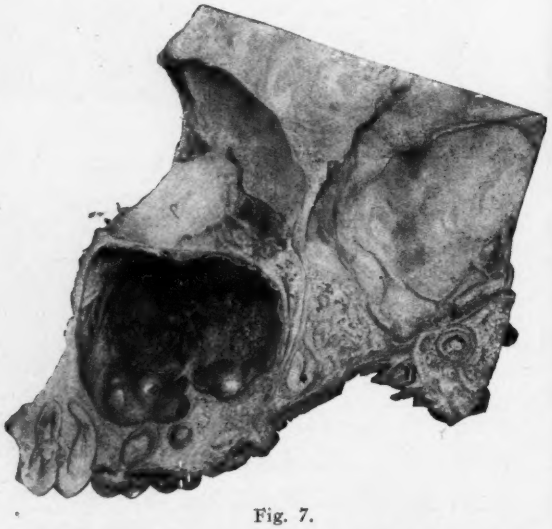

Fig. 7.

Fig. 6.—Showing considerable thickness of bone between the apices of the molar roots and the maxillary sinuses. (Cryer.)

Fig. 7.—Showing smooth prominences in floor of maxillary sinus overlying apices of roots of premolar and molar teeth. (Cryer.)

gram as a dark shadow which might be mistaken for a cystic or abscess cavity in the bone (Figs. 4 and 5).

Above the apices of the premolar and molar teeth is found the maxillary sinus or antrum of Highmore. This sinus varies very much in its extent, shape, and in the relation of its floor to the roots of the teeth. Sometimes there is

Fig. 8.—Showing floor of maxillary sinus dipping down between roots of molar tooth, the apices thus being above the level of the floor. (Cryer.)

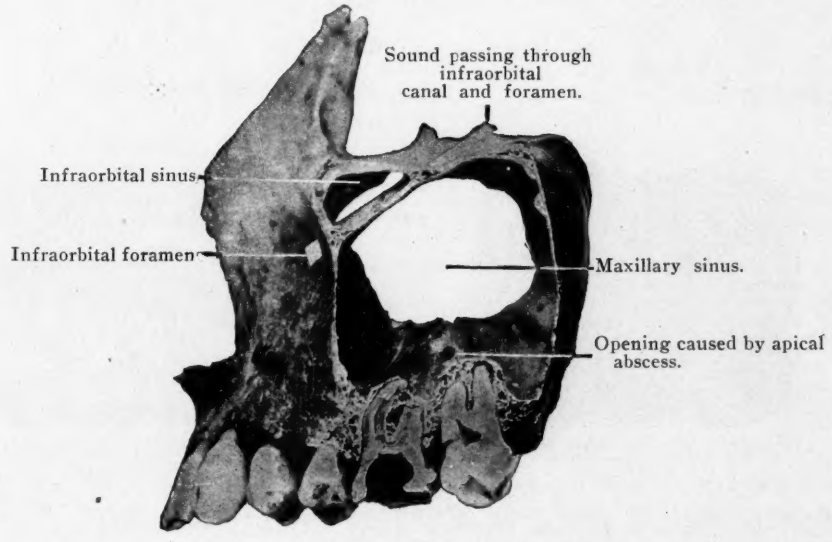

Fig. 9.—In this specimen the maxillary sinus does not extend much anterior to the first molar. (Cryer.)

a considerable thickness of bone between the tooth apices and the sinus (Fig. 6). In other cases the tooth apices come right up to the floor of the sinus, even forming projections into the cavity, though under normal conditions always

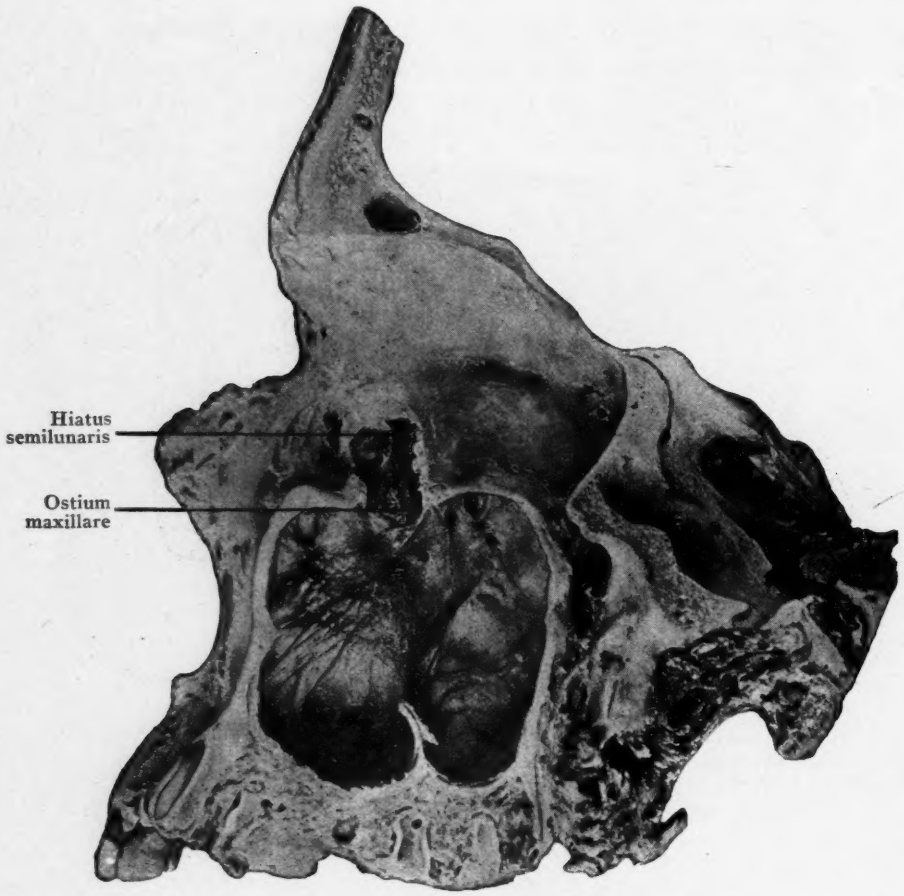

Fig. 10.—Here the floor of the maxillary sinus extends in front as far as the region of the first premolar tooth. (Cryer.)

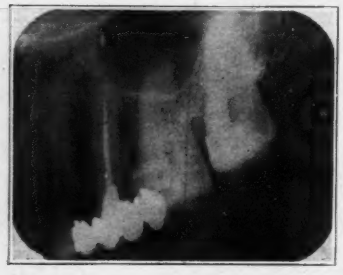

Fig. 11.

Fig. 12.

Fig. 11.—Upper right canine normal. First premolar good root filling, apex extends close to floor of maxillary sinus. First molar roots apparently project into maxillary sinus, but in reality are in the wall of the sinus; furthermore, this tooth has a vital pulp.

Fig. 12.—Upper right canine and premolar normal. First molar roots project above level of floor of maxillary sinus, but the normal dense line of bone can be seen surrounding the roots. The pulp of the tooth also is vital.

separated from it by a thin lamina of bone (Fig. 7). Sometimes the ends of the roots are found well above the most dependent portion of the sinus, but located in its wall (Fig. 8). The floor of the maxillary sinus is usually found in relation to the roots of the molar teeth (Fig. 9), but may extend as far forward as the first premolar or canine (Fig. 10). These varying relations of the floor of the antrum of Highmore to the roots of the teeth are well shown in x-ray negatives, the cavity of the antrum appearing as a dark shadow which must not be mis-

Fig. 13.

Fig. 14.

Fig. 13.—Showing anterior palatine fossa just behind and between the upper central incisor teeth. The posterior palatine canal is seen as a groove running parallel to and just within the line of the molar teeth. (Cryer.)

Fig. 14.—Upper central incisors. Sharply defined dark area between roots is anterior palatine fossa, somewhat resembling the appearance of bone destruction and cyst formation. Both teeth, however, contain vital pulps, and normal peridental line can be followed around each root.

taken for a rarefied disease area. It is sometimes difficult in the study of roentgenograms of this region to determine whether or not the roots of the teeth project into the maxillary sinus and whether areas of absorption about the roots communicate with it. In the roentgenogram, where a root is projected above the level of the floor of the antrum, it is important to seek carefully the dark and light lines found around normal teeth in order to differentiate the normal condition shown in Fig. 8 from pathologic conditions in which roots communicate with the cavity of the sinus (Figs. 11 and 12).

In the upper jaw, on the palatal surface just behind and between the central incisor teeth is found the *anterior palatine fossa* (Fig. 13). This contains

foramina carrying blood vessels and nerves from the nose. In roentgenographic films of the anterior teeth this fossa is frequently seen as a dark shadow above and between the apices of the central incisors, and when in close relation to roots of teeth under suspicion, might be mistaken for rarefaction due to disease of the bone (Fig. 14).

The *posterior palatine canal* (Fig. 13), is found in the form of a groove running posteroanteriorly in the roof of the mouth mesially to the molar teeth. In the roentgenographic film it is occasionally shown as a dark shadow in the wall of the antrum in close relation to the palatal roots of the molar teeth.

ROENTGENOGRAPHIC ANATOMIC LANDMARKS IN THE LOWER JAW

Here the principal roentgenographic anatomic landmarks are the *mandibular canal* and the *mental foramen* (Fig. 15). The *mandibular canal* runs postero-

Fig. 15.—Showing cancellated internal structure of mandible, with mental foramen below and between roots of premolar teeth. (Cryer.)

anteriorly below the apices of the teeth, and sometimes in very close relationship with them (Fig. 21). In the roentgenogram the root of a lower molar may apparently project into the dark space representing the canal, yet in reality be situated to one side or the other.

The *mental foramen,* situated below and between the lower premolar teeth, may easily be mistaken for an area of disease associated with one of these teeth, particularly if there are clinical signs giving a suspicion of trouble (Fig. 16). Very frequently, however, the connection of the mental foramen with the inferior dental canal can easily be seen in the roentgenogram (Fig. 17).

In films of the upper premolar and molar region the overhanging malar bone frequently casts a shadow which obscures the roots of these teeth (Figs. 18 and 19).

ANATOMIC LANDMARKS IN ROENTGENOGRAPHIC PLATES OF THE JAWS

In a lateral roentgenographic *plate* of the upper and lower jaws, made with the head in the position shown in Fig. 20, attention is called to certain anatomic landmarks, which are shown in Figs. 21 and 23, and diagrammatically in Figs. 22 and 24. The upper and lower teeth of the side examined are usually well shown from the third molars forward to the canines. In the anterior portion of such a plate, the shadow of the opposite side of the jaws overlies that of

Fig. 16.

Fig. 17.

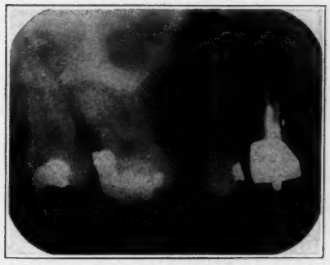

Fig. 18.

Fig. 19.

Fig. 16.—Lower right canine normal, first premolar normal; second premolar pulpless, imperfect root filling, periapical thickening of peridental membrane. Between and below apices of premolars is seen a dark area due to mental foramen.

Fig. 17.—Lower right first premolar, pulpless, apparently good root filling, no periapical abnormality. Second premolar recently removed. Inferior dental canal seen curving up to mental foramen near socket of this tooth. First molar, large filling and caries of crown. No abnormality of bone.

Fig. 18.—First premolar crowned, two roots, one much foreshortened; good root fillings, apices normal. Other teeth normal. First molar missing. Second and third molar roots overshadowed by malar bone.

Fig. 19.—Upper left premolars, pulps vital, periapical regions normal. Circumscribed dark area about apex of second premolar somewhat resembling an area due to rarefying osteitis is only due to a recess in the maxillary sinus; the normal line of bone can be traced completely around the apex of this tooth. Light shadow in upper left corner is due to malar bone.

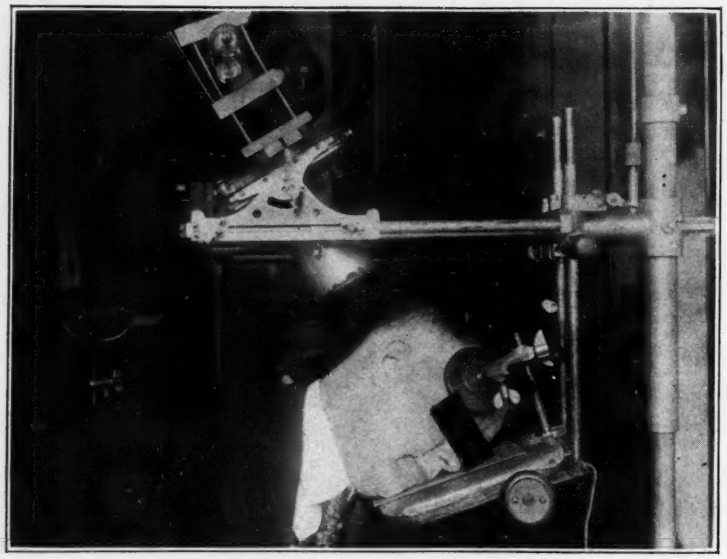

Fig. 20.—Position of head and angle for left side of jaws.

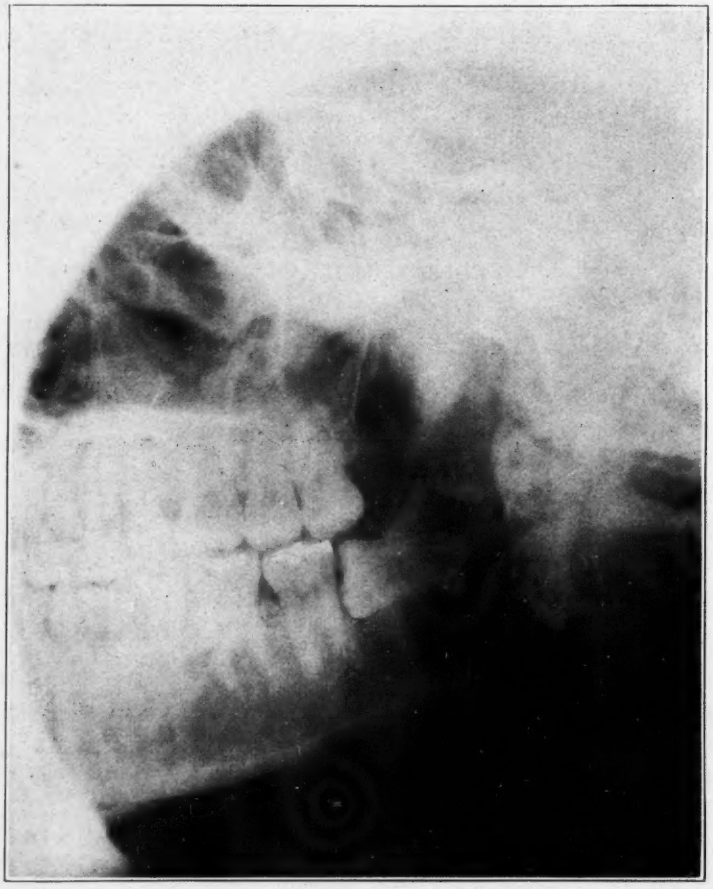

Fig. 21.—Plate of right side of face, with head placed especially to show molar region. Horizontal impaction of lower third molar. (See Fig. 22.)

the side nearest the plate, the amount of overlapping depending on whether the patient's nose is pressed down on the plate or slightly raised from it. In the same way the position of the head affects the overlapping of the molar region by the shadows of the vertebræ at the posterior portion of the plate. The dark space above the upper teeth is formed by the maxillary sinus and the nasal fossa. Into this space occasionally may be seen projecting the coronoid process of the opposite side of the jaw. Above the maxillary sinus and nasal fossa, the honeycombed appearance is due to the ethmoid cells. Below the roots of the lower

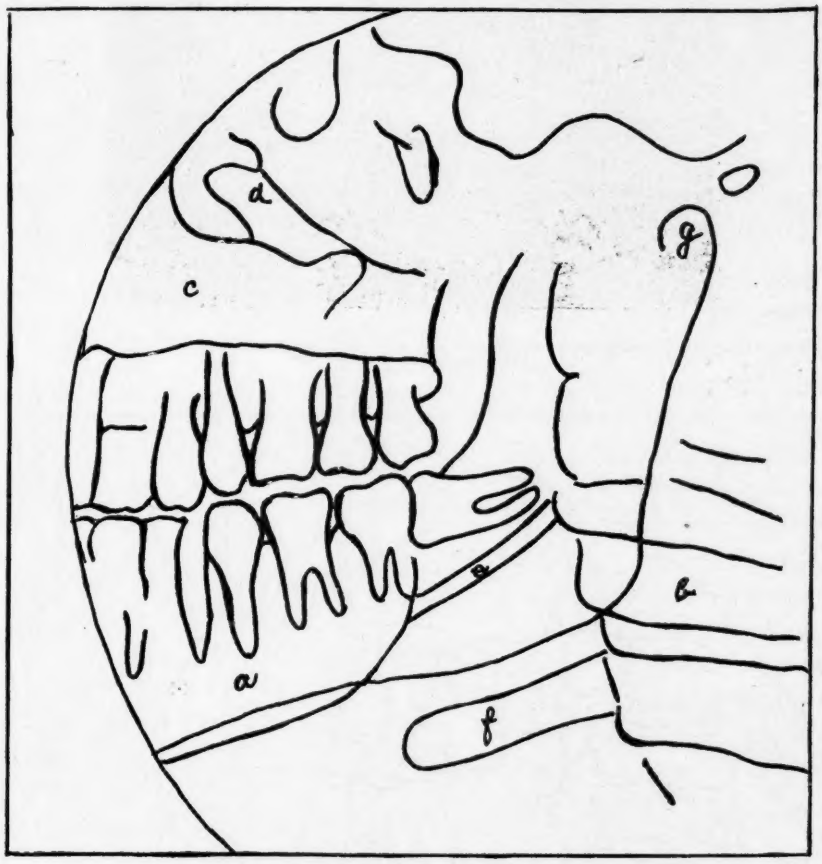

Fig. 22.—Diagrammatic illustration of Fig. 21.

(*a*) Portion of lower jaw overlapped by shadow of opposite side.
(*b*) Vertebræ.
(*c*) Maxillary sinus and nasal fossa.
(*d*) Region of ethmoid cells.
(*e*) Mandibular canal.
(*f*) Hyoid bone.
(*g*) Condyle of mandible.

molar teeth may be seen the mandibular canal, running forward to the mental foramen between and below the apices of the premolars. Below the lower border of the mandible, extending in front of the vertebræ as far forward sometimes as the first molar, the hyoid bone is shown. In plates taken to show the molar region, the ramus and condyloid process of the mandible can frequently be traced up to the joint.

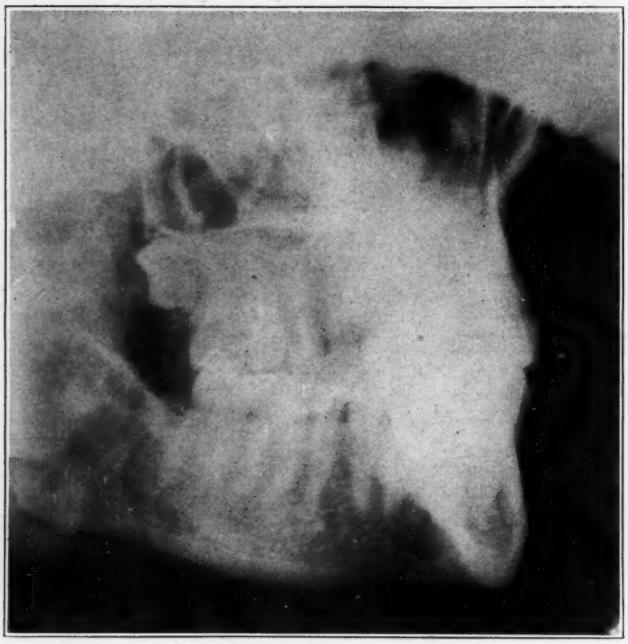

Fig. 23.—Plate of left side of face, showing normal anatomic landmarks and impacted upper third molar. (See Fig. 24.)

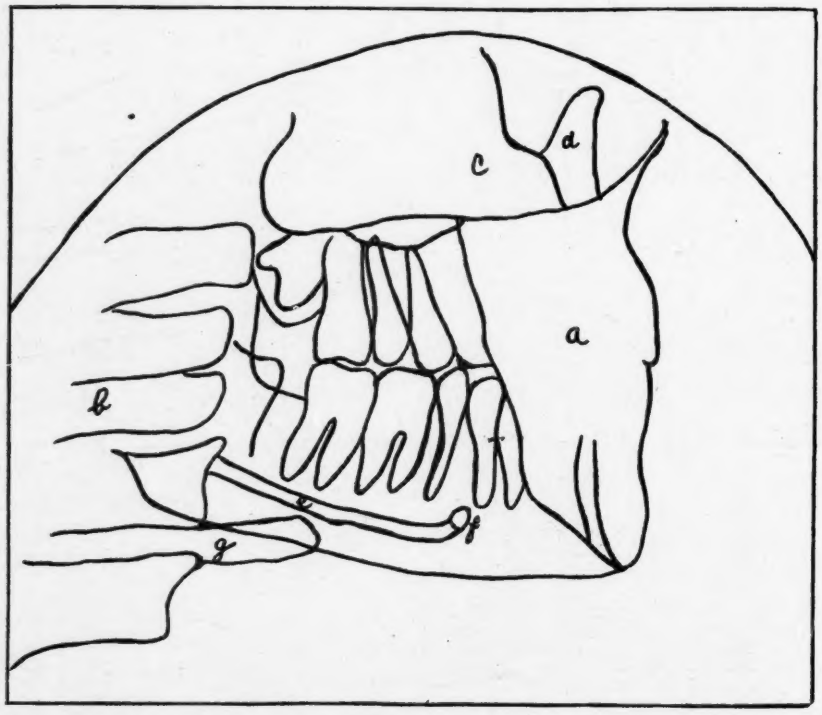

Fig. 24.—Diagrammatic illustration of Fig. 23.

(*a*) Portion of upper and lower jaws overlapped by shadow of opposite side.
(*b*) Vertebræ.
(*c*) Maxillary sinus and nasal fossæ.
(*d*) Coronoid process of right side of mandible.
(*e*) Mandibular canal.
(*f*) Mental foramen.
(*g*) Hyoid bone.

A NEW DENTAL ROENTGENOGRAPHIC FILM HOLDER

By Norman C. Prince, M.D., Omaha, Nebr.

Attending Roentgenologist to the Omaha Free Dental Dispensary for Children; Etc.

HAVING tried most of the dental film holders on the market and found them wanting in some way and also realizing that to have the patient endeavor to do the job is anything but satisfactory, I determined to get up some device that would make dental roentgenography somewhat less irksome. Having determined that holding the film with the thumb was the most satisfactory method, I endeavored with this device shown in Figs. 1 and 2 to imitate this as nearly as possible.

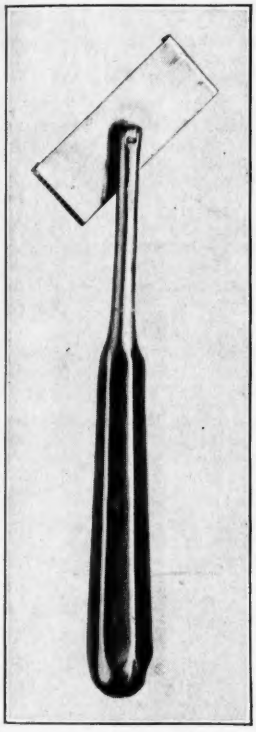

Fig. 1.

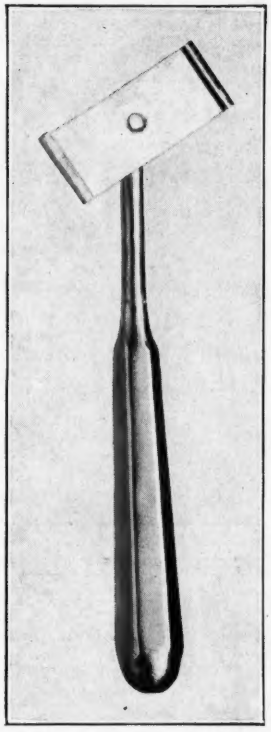

Fig. 2.

The instrument is composed of a small piece of thin metal 1⅝x⅝ inches with a turn on either end so the film may be held firmly. This enables one to use various widths of films from the narrowest to the broadest. A small piece of metal is riveted into the center of this so that it will revolve freely, and onto this small piece a handle is fastened with a hinge joint. This gives a complete universal joint. The holder is placed in the mouth with the firmly held film in position. The patient now holds the handle firmly and the exposure is made.

From the fact that the handle can be placed at any angle to the plane of the film, it is very simple to use this device, and I believe it will become very useful to those doing dental roentgenography. The entire instrument is nickel plated and between exposures is placed in a weak antiseptic solution.

The Fifty-first Annual Meeting of the Tennessee State Dental Association will be held in Nashville, Tennessee, June 17, 18, and 19, 1918.—Geo. L. Powers, Secretary, Paris, Tenn.

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EDITORIALS

Malocclusion and Mouth Infection

AT the present time the medical and dental professions are paying a great amount of attention to mouth infection, and various causes have been given for the production of the condition. Mouth infection is a term that has been coined in late years to include a condition in which the oral cavity is laden with germs to such an extent as to become a detriment to the individual, in a great many cases producing systemic effects.

It must be remembered that in the mouth of every individual there are always some germs present, but it is only when the germs become so numerous as to produce disease of the tissues in the oral cavity with resulting systemic disturbances that we think of the condition as being one of mouth infection. There is no question but that mouth infection primarily is produced by some microorganism, but as microorganisms are present at all times, in order to

make possible infection of the oral cavity, some condition must exist that is conducive to their increase. When we begin to look for a cause, we find that the principal factor, after the germ itself, in the production of mouth infection, is malocclusion.

Malocclusion is considered by some men who have made mouth infection a study as being more important in the production of this condition than any other one thing. The life of every individual is simply one continuous fight between the cells of his body and the invading microorganisms, a continuous battle is going on between the leucocytes and the germs, and finally the time comes when the germ gets the better of the argument and the individual succumbs to the attack of the invading organism. Therefore, in order to make this battle more favorable for the cells and for the individual, everything possible should be done that will prevent the growth and multiplication of the microorganisms or the invading germs. Now one of the things which allows the germs in the mouth to become numerous is malocclusion, producing the abnormal placing of the teeth, improper position of the contact point, which makes the proper cleansing of the mouth impossible. It has been contended by some that if teeth had normal occlusion and the individual masticated the proper kind of food, mouth infection would practically be an unheard of thing even without the aid of any artificial means of cleansing the teeth. However, at the present time individuals do not masticate their food properly, and, as a rule, do not have the kind of foods that require a vigorous mastication.

Various artificial means have been introduced for cleansing the oral cavity, which are very good and proper. We do not advocate that because individuals have normal occlusion they should never brush their teeth, but we do say that an individual whose teeth are in normal occlusion can more thoroughly cleanse his oral cavity than the individual whose teeth are in malposition. Take the majority of individuals suffering from mouth infection, and you will find they first were sufferers from malocclusion. These malocclusions may have existed from childhood, or they may have been produced by improper filling and restoration, or by the extraction of teeth; but the fact remains that the malocclusion exists from some cause, at the time the mouth infection becomes apparent. It is also strange that we find a large number of mouth infections present in individuals who have spent considerable time in cleansing the teeth. We are willing to admit that they did not succeed in cleaning the teeth or probably the mouth infection would never have occurred. The fault of improper cleansing may have been the result of improper methods, but in a large number of cases it has been the result of insufficient cleanliness owing to the malposition of the teeth. We have observed very young individuals with malocclusion in whom mouth infection was very manifest.

We have seen existing infections treated, the teeth placed in proper occlusion, with the result that infection did not occur again during the period the case was under observation. We can not say that an individual who has a set of teeth in normal occlusion will never have a case of mouth infection, but we can say that he will not be so liable to as the individual whose teeth are in malocclusion. We can practically rest assured that an individual whose teeth are in malocclusion will suffer from mouth infection before he is forty years

of age regardless of any care or treatment that he may give his teeth at the present day and age.

Realizing that malocclusion is such an important factor in the production of mouth infection, we are surprised that dental literature does not contain more on the subject. Only in the last few months there has appeared a dental textbook that has given considerable space to mouth infection in which the author has failed to mention malocclusion as being one of the contributing factors to the condition. It seems to us a very foolish procedure for writers to advocate the continual cleasing and brushing of the teeth, the use of prophylactic means, when they neglect the first and most important prophylactic measure nature has provided; namely, the teeth in normal occlusion, with the surfaces of those teeth made as nearly as possible self-cleansing.

We believe the time is not far distant when the most important advice given regarding prophylactic measures, the most important means regarding the prevention of mouth infection, will be that the teeth be placed in normal occlusion. We believe that malocclusion will be recognized as a pathologic factor in the production of mouth infection.

American Institute of Dental Teachers

AT the last annual meeting of the American Institute of Dental Teachers, held at Pittsburgh, Pennsylvania, January 29-31, 1918, the following officers were elected: President, Dr. A. W. Thornton, McGill University, Dept. of Dentistry, Montreal, Que.; Vice-President, Dr. R. W. Bunting, Ann Arbor, Mich.; Secretary-Treasurer, Dr. Abram Hoffman, 381 Linwood Avenue, Buffalo, N. Y.; Executive Board, Dr. A. D. Black, Chicago, Ill.; Dr. G. S. Millberry, San Francisco, Cal.; and Dr. A. H. Hipple, Omaha, Neb.

The next annual meeting will be held January 28, 29, and 30, 1919, the place of meeting to be announced later.

The Use of Suitable Metals for Orthodontic Appliances

A FEW years ago the question of the selection of metals to use in the construction of orthodontic appliances was considered from the appearance of the metal and its cost. Appliances were divided into base and noble metal appliances, and the principal points in choosing the appliance were the cost of construction, the appearance, and the antiseptic value of the metal forming it. When all appliances were practically of the same style, the question of the selection of metals was a much simpler proposition. As the treatment of malocclusion became more important and the construction of an appliance to fit the particular case was given more consideration, and appliances were divided into labial and lingual devices, the question of selecting the material became more important than it was in times past. Even in the selection of an ordinary labial alignment wire it is important to consider what is to be accomplished by that wire when considering the material of which to construct it.

If the alignment wire is to be used for the expansion of the dental arch

which must be accomplished by the elasticity of the alignment wire, one metal of a certain gauge might be suitable, whereas, if the alignment wire was to be used for increasing the length of the arch by the use of the screw, another gauge and another material might be more suitable. In the construction of bands the metal which is selected must be considered with regard to its strength as a band material, the ease with which it can be conformed to the tooth, and its antiseptic properties. Unfortunately, at the present time we cannot find all of the desired qualities in one band material, consequently the kind of band material which is used will have to be decided upon the likes and dislikes of the operator which should be governed by the clinical condition of the teeth. In the mouth of an individual whose teeth show decided tendency to caries, it would be very poor judgment to use a band material that did not possess antiseptic properties. Again in the mouth of the patient who keeps the teeth religiously clean and where there is evidence that the band material will be subjected to considerable stress during mastication, the selection of a stronger and stiffer band material, even though it does not possess antiseptic properties, may be advisable. When we come to the selection of the material or metal of which the appliance is constructed, we must be governed almost entirely by the style of the appliance that is to be used, and the manner in which the force is to be exerted on the malposed teeth.

We have already mentioned some of the conditions that enter into the selection of the ordinary labial alignment wire, but, we must consider the fact that in the conditions in which we formerly used the ordinary labial alignment wire we now have ribbon arches fitted to the appliances, labial arches with finger springs, and lingual alignment wire. We even have the lingual alignment wire which is soldered on the band where the force is obtained by the means of the wire-stretching pliers, and the lingual alignment wire which can be removed from the molar attachment and which exerts force on the malposed teeth by the elasticity of the metal of which it is constructed.

In considering, then, the two types of lingual alignment wires which we may roughly classify as fixed and removable, it should be very apparent to every one that metal suitable for a removable lingual alignment wire, which exerts force upon the teeth by means of its elasticity, would not be advantageous for the lingual alignment wire where the force is exerted by means of the wire-stretching pliers.

Dr. Mershon has specifically stated that the lingual removable alignment wire suggested by him should be constructed of a high-grade spring gold. When the appliance is constructed from this material, the results accomplished are very satisfactory. However, we know of a number of men who have attempted to use removable lingual alignment wire and have attempted to construct it from other materials than those recommended by Dr. Mershon with the result that the use of the appliance has not been satisfactory. If you consider the physical property of the appliance, the manner in which it is constructed, it should be apparent to any one that the only material that will accomplish the desired result is a high-grade spring gold which will possess the elasticity to exert the required force on the malposed teeth.

Some men who have used the removable lingual alignment wire constructed of spring gold have also attempted to make the fixed alignment wire of the

same material, using the wire-stretching pliers to exert the force. It has been proved by various experiments that spring gold is not a suitable material to use in conjunction with the wire-stretching pliers. Any material that is used with the wire-stretching pliers should be a material that possesses very little elasticity and one that possesses considerable strength and rigidity, and still a reasonable amount of softness to enable it to be pinched by the wire-stretching pliers. The only metal that possesses these qualities is iridioplatinum, which a great many men have attempted to avoid using, owing to the high price at the present time. However, we would caution those who desire to use the wire-stretching pliers to leave them alone, or use them only on iridioplatinum, which is the only material that possesses the proper requirements for their successful use. There are some alloys of German silver which more nearly approach the quality of iridioplatinum than anything we have found, but the difficulty with the alloys of German silver is that they may be rendered too soft during the process of soldering.

With the use of the labial arch and the finger spring or with the use of a finger spring on a lingual alignment wire, it necessarily follows that the finger spring must be constructed of spring gold with a large amount of elasticity and with a large amount of strength which will enable the spring gold to be used of the necessary small gauge. The use of any other material for finger springs besides the high elastic spring gold is going to result in failure because no other metal possesses the required spring necessary. In using finger springs, either straight or with the J-extension for the purpose of rotating teeth in conjunction with the bands and tubes, we would again caution all who attempt to use this appliance that, if the finger spring is to be satisfactory, it must be constructed of the proper material. For the construction of the concealed labial arch, which should be used in conjunction with the finger spring, it must be remembered that the elasticity of that appliance is confined principally to the finger spring and, therefore, the labial arch or alignment wire does not necessarily have to possess a high degree of elasticity. In fact, unless there is a particularly good reason why the labial alignment wire used with the finger spring should have an elasticity, it is preferable to use a metal which is more rigid and which is more liable to keep its shape and avoid displacement of the molar anchorage than would be a high elastic labial alignment wire. We realize that if the labial alignment wire is to be used as an active moving appliance for the expansion of the molars or other parts of the dental arch, then an elastic metal should be used. However, we would caution all who use this appliance to remember that the greatest amount of elasticity and the greatest amount of tooth movement is to be accomplished by the finger spring, and the alignment wire is simply a base which holds the finger spring in position while it exerts force on the malposed teeth. Owing to the unsatisfactory results we have seen when men attempted to use these styles of appliances constructed of metal which was contraindicated, we caution all to consider properly the properties of their appliance and the selection of the metal to see whether it is suitable to accomplish the purpose they desire before they attempt to make the appliance.

The little time spent in the careful consideration of metals will very often lead to much more satisfactory results, or, in some cases, eliminate failure entirely.